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Report

VALUE CIRCULATION MANAGEMENT SYSTEMS

Submitted to

NTT DATA CORPORATION

Revised
March 11, 1997

Prepared by

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Value Circulation Management Systems

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A. Status of Current Value Circulation Management Systems (VCMS)

INPUT assesses business uses by industry (including currently operational systems as well as pilots and announced plans) in the following application areas:

- Transaction involving the purchase of goods and services
  - Current offerings by major providers
  - Enabling technology
- Reserved travel (business travelers)
- Unreserved travel and vehicle tolls
- Health care
- Government-supplied services
- High volume specialized services
- Economic Exchange
- Product warranty

1. Transactions for Goods and Services--Smart Cards

a. Summary

This section describes Smart Card-based VCMS applications in nine areas. This summary section summarizes each of the offerings across six categories. The categories are shown in Exhibit 1. (Exhibit also shows the relationship between each category and the "5Ws/1H" questions.)

Exhibit 1

Summary Points for Analysis of VCMS/SmartCard Offerings

5WS/1H	Analysis Heading
WHO	Vendor Name
WHERE	Location/User
WHEN	Date(s)
WHAT	Description of offering
HOW	Implementation Method
WHY	Targeted Needs

Summary of Proton Offering

Vendor`	Proton
Location/Users	Belgium
Date	February 1996
Description of Offering	Electronic purse, aimed at small consumer transactions similar to Mondex
Implementation Method	SmartCard, no PIN. Requires special Secure Application Module terminal. Audit trail feature
Targeted Needs	Cash replacement for small purchases payphones, taxis, etc.

Summary of AT&T Offering

Vendor	AT&T
Location/Users	U.S. (Delta Airlines);Italy (highway toll collection)
Date	1995
Description of Offering	Licensed SmartCard to be integrated into many technologies and applications (e.g. Lockheed Martin in U.S.; Girovend Ltd in Europe)
Implementation Method	Contactless microcomputer driven SmartCard to be integrated into third party offering
Targeted Needs	Designed to be very flexible to meet diverse requirements

Summary of SBS-X Offering

Vendor	Siemans Nixdorf
Location/Users	SmartCard application being implement
Date	1995
Description of Offering	Upgrade from magnetic stripe to microprocessor technology. Being licensed to integration
	Implementation Method To be integrated into third party offerings
Targeted Needs	

Summary of VISA CASH Offering

Vendor	VISA
Location/Users	Worldwide Implementation Planned
Date	1996
Description of Offering	Both disposable and reloadable cards are being offered
Implementation Method	Can be sold as standalone (pre-loaded) or updated by an ATM
Targeted Needs	Cash replacement

Summary of MONDEX offering

Vendor	Mondex International Sweden
Location/Users	UK (test in Swindon, now completed); smaller tests in Hong Kong and Canada
Date	1995
Description of Offering	Stored value SmartCard/electronic purse
Implementation Method	Proprietary card readers in shops and other merchants
Targeted Needs	Cash replacement

Summary of CAFE Offering

Vendor	Conditional Access for Europe (European Community ESPRIT Program)
Location/Users	European prototype
Date	1992-95
Description of Offering	Flexible electronic purse to handle identification payments and/or information access
Implementation Method	Personal Digital Assistant with SmartCard capabilities
Targeted Needs	Wide variety of consumer information and transaction needs

Summary of IC Card Cashless Payment Offering

Vendor	NTT DATA COMMUNICATIONS
Location/Users	Japan
Date	1996
Description of Offering	IC cards refilled from special terminals linked to bank account
Implementation Method	Upgrade from prior offering which required insertion of cash
Targeted Needs	Cash replacement

Summary of Pocket Money Offering

Vendor	University of Arizona
Location/Users	U.S.
Date	1994
Description of Offering	Microchip identification which allows entrance to buildings, library and debit card transactions.
Implementation Method	IC card replaced identification cards and building access cards. Transaction capability added.
Targeted Needs	Students and Staff in a campus environment.

Summary of Public Access Terminals Offering

Vendor	Public Access Terminals
Location/Users	U.S. (Libraries)
Date	1996- Prototype
Description of Offering	Controls admission, check out of library materials and method of payment for library equipment.
Implementation Method	Card can be debit card or stored value
Targeted Needs	All services in a library environment

b. Proton

The Proton electronic purse was launched in February 1996 with 100,000 cards in Belgium. Proton offers the same advantages of convenience for shoppers and consumers, and to most users would appear similar to the Mondex scheme. Proton does not require a PIN number for transactions, and the card can be transferred to other users, although it does not allow direct person to person transfers of funds. Payments for purchases can only be made to merchants who have a SAM (Secure Application Module) for authorization and transfer of funds. The Proton card is targeted at small transactions at neighborhood shops, vending machines, payphones, taxis, and other mobile vendors. Banksys believes Proton can be used for payments in other countries, particularly in the EU, and is an active participant in discussions for establishment of Electronic Purse standards. This is a 'post payment' system with an audit trail and no person-to-person funds transfer. Other electronic purse schemes that fall into this category are the Danmont system, (Denmark), Europay (EC), and SIBS (Portugal).

c. AT&T

AT&T's innovative Smart Card technology could become the world's standard for cashless wallets and electronic commerce. AT&T recently announced that it will license its "contactless" Smart Card technology, featured in the company's futuristic "You Will" television advertising, to customers in the U.S. and around the globe who want the cards to speed transportation access, highway toll-collections, banking transactions, cashless retail purchases and other uses. AT&T's Smart Cards are being used by a number of companies for a variety of purposes:

- AT&T and Lockheed Martin are working with companies to develop building security and other sophisticated security applications for the cards, which AT&T itself will be using for employee identification and building security in its offices worldwide. AT&T said it will help customers who license the technology develop applications for:
- Transportation
- Delta Airlines' Shuttle service for ticketless boarding on flights in the northeastern United States.
- Highway toll-collection in Italy
- Cashless vending machine company (GiroVend Holding Ltd.) in the U.S. and Europe.
- AT&T is also working in banking, retail, security and health.

AT&T's Smart Cards have the following features:

- Contain 8-bit microcomputers complete with their own operating systems in a credit-card sized package

- Use a contactless technology, that is, they don't have the exposed metallic contacts of some other Smart Cards, which are subject to wear, contamination and static electricity damage.

- Use a patented design and interface invented at AT&T Bell Laboratories that can be read by placing the cards on or into ATMs, vending machines, various point-of-sale card readers, and other devices.

- Card bearers must pass whatever security tests have been programmed into the cards. The cards may contain digital photos, fingerprints, voice prints, signatures or other encrypted information. Then, when verified, card holders may gain entry to buildings or computer terminals, complete their purchases, receive boarding passes, or conduct dozens of other possible transactions—all with a single card. The memory for AT&T cards is designed for 100,000 write and erase cycles—a 10-year life or longer.

d. SBS-X

SBS-X offers a standard solution from Siemens Nixdorf for central server functions in self-service and cashless payment systems. In addition to the magnetic card, the SBS-X Smart Card (called a "chipcard") is being used to an increasing extent. It can handle the usual functions of the magnetic card, but with a considerably higher standard of security. Moreover, chipcard technology opens up a host of possibilities for new applications, including, for example, the "electronic paycard" function.

Whether magnetic cards or chipcards are employed, in all systems for cashless payment or self-service a number of functions are required in central servers or background systems to ensure secure handling of the transactions themselves and deal with post-processing. The functions must be designed for uninterrupted 24-hour operation, and range from authorization of a cash withdrawal, through the charging of the electronic paycard, to the accounting of retailer charges in a POS network.

e. VISA Cash

Visa is the largest consumer payment system in the world with more that 12 million acceptance locations. Visa member financial institutions have issued more than 390 million cards worldwide. Visa also has the leading global ATM network.

In a move that will allow financial institutions to deliver broader services to consumers, Visa has introduced Visa Cash, a stored value card. VISA Cash is a new way to pay for everyday necessities--small purchases such as a cup of coffee, newspaper, pay phones, cinema tickets, or public transportation.

There are two main types of VISA Cash cards: Disposable and Reloadable.

- Disposable cards are loaded with a pre-determined value. These cards typically come in denominations of local currency, such as US $10. When the value of the card is used, the card is discarded and a new card may be purchased. These cards may be dispensed from machines called Card Dispensing Machines (CDMs) which accept a variety of payment methods.

- Reloadable cards come without a predefined value. Cash value is reloaded onto the card at specialized terminals and Automated Teller Machines (ATMs). When the value is used up, one can load the card again.

VISA Cash cards work like "electronic money". A microchip embedded in each plastic card stores monetary value. Each time one uses VISA Cash to pay for something, the purchase amount is automatically deducted from the balance. Users will be able to use VISA Cash wherever they see the new VISA Cash logo displayed - including merchants where users use coins or small bills to pay, such as quick serve restaurants, public transportation, convenience stores, gas stations, cinemas, and pay phones.

Visa is implementing a variety of stored value card pilots in selected cities in all five Visa regions: Asia-Pacific, Canada, Europe/Middle East/Africa, Latin America, and the United States. For example, in Europe, where chip cards are already established, many banks offer stored value programs for domestic usage. Visa will provide these institutions with multi-currency capability so the cards can be used internationally.

In Australia, Visa has recently announced its efforts to support a national stored value program supported by major banks in that country.

In Latin America, Visa Argentina and Visa Colombia will issue combination cards, which feature stored value as an added function on Visa debit and Visa Electron cards. Visa, Inbursa, and TELMEX have started negotiations to launch a co-branded Visa card in Mexico that will contain a stored value chip that can be used at TELMEX pay phones throughout Mexico.

Four U.S. financial institutions will roll out the card this year, with follow-on launches planned sequentially next year. Bank of America will begin issuing stored value cards at Visa International headquarters next month when more than 2,000 employees will be able to use the card to make purchases at vending machines and in the company cafeteria.

- Visa showcased this innovative new payment at the Olympic Games in Atlanta. The card was used instead of cash to pay for food, beverages and other needs. To be ready for the Olympic Games, NationsBank planned a pilot project of Visa's new card in Georgia and Virginia.

- Wachovia Bank also participated in the launch.

- Chase Manhattan, Citibank, MasterCard and Visa announced an initiative to launch a pilot program introducing chip-based stored value cards in the New York City market, in the fourth quarter of 1996. The Smart Cards will have an embedded computer microprocessor that expands the function and power of traditional credit or debit cards.

- Chase and Citibank will issue about 50,000 of the new chip cards to consumers, which will be accepted by approximately 500 merchants in a defined geographic area of Manhattan. The goals of the pilot are to test the dynamics of consumer and merchant acceptance of the new cards.

- The pilot, which is jointly sponsored and supported by the four parties, will be the first test of chip-based stored value products in the New York market. MasterCard and Visa have each independently developed different stored value products called MasterCard Cash and VISA Cash. This pilot will allow merchants to accept cards with chips from either brand with a single merchant terminal, just as they do with traditional credit cards today. This is the first test of two different stored value products, which will be accepted in the same terminal.

- Citibank and Chase have been leaders in electronic banking and the use of technology to deliver more personalized service. The two banks are always looking for ways to strengthen the relationships they have with their customers, and believe the new card will add value to existing checking, savings and credit card relationships. In addition, the banks believe that by advancing the state of the art in cards now, they will be able to offer customers more and more interesting and valuable capabilities on the chip card in the future.

- The new stored value products are designed for payments under $20. The reloadable stored value function is added to an existing credit or debit card, thus enhancing the value of the card that the consumer already carries, as well as the relationship between the bank and the cardholder. A customer can easily put money on the card—which is stored in the chip—at ATMs or at other terminals. Cards can be used for small purchases made at news stands, fast food restaurants, pay phones and gas stations.

Stored value products will offer New York consumers a quick and convenient alternative to cash. The card will be accepted at a wide variety of merchants, many of whom don't currently offer any payment option except cash. Research conducted by each pilot sponsor shows that consumers want the convenience of a stored value payment option. Merchants, too, will benefit from stored value card technology by being able to offer customers a more convenient way to pay, while reducing cash and check handling costs.

Visa sees microprocessor chips as the key enabling vehicle for the next generation of payment technology. While stored value cards offer consumers a handy new alternative to carrying bulky cash and coins, they also provide a technology stepping-stone to full electronic banking. By utilizing the data processing power contained on an integrated circuit, Visa can "chip" away at traditional payment systems and suggest new ways for financial institutions to package services beyond account information on a consumer's card.

- Microprocessors embedded in stored value cards can currently store approximately 80 times the amount of information currently contained on a magnetic stripe. The chip's processing capability significantly improves security and provides for additional applications to be placed on the same card along with the stored value function.

- According to independent research commissioned by Visa in Asia (Australia and Japan), Canada, Europe (Germany and United Kingdom), Latin America (Argentina and Mexico), and the United States, the opportunities for stored value cards are enormous, and 83 percent of the consumers polled said they would use the card instead of cash because of its speed, convenience, and simplicity.

- Many merchant locations (including automated vending machines, parking meters, pay telephones, buses, taxis, toll booths, video game machines, fast food restaurants and school cafeterias) do not accept payment products such as credit cards, debit cards or checks as payment today. Nevertheless, Visa research showed they would derive benefits such as immediate payment for goods, increased sales, time savings in handling, sorting and replenishing coins, cashier handling errors and theft.

- A major advantage of stored value cards over cash and coin will be the acceptance of the card at unattended locations where exact change is required. With stored value cards, consumers will always have exact change; and automated machine vendors will realize greater profits due to theft reduction and reduced maintenance costs.

An open system architecture is a critical element that differentiates Visa's strategy. While many current stored value products adhere to the ISO 7816 standard, they lack the commonality of implementation specifications and guidelines that would allow them to be interoperable, thereby making them closed-loop systems.

- Visa has been working with the world's major stored value system operators, as well as key banks and payment systems, to develop industry-wide specifications for the global operation of stored value cards and supporting equipment.

- Visa has also formed a vendor partnership program the world's market leaders in the consumer payments industry to develop terminals and cards designed to support common chip specifications. The goal is to ensure interoperability, so a consumer's card can work in any stored value system around the globe. In addition, by ensuring that stored value cards are compatible with various payment systems, consumers will be able to load value at Visa/PLUS ATMs anywhere in the world where stored value cards are implemented. It also ensures the eventual capability for smooth clearing and settlement of international transactions.

- Visa is working to supply stored value cards and card-accepting terminals that can provide banks with a turnkey system for stored value operations. In addition, Visa has expanded VisaNet to support the clearing and settlement of financial value sourced from purchases using stored value cards.

Visa has three cornerstone principles that will further differentiate its system from others. First, the system has accounting controls and is auditable. While stored value card transactions are anonymous, blinding is the technique used to relate a payment to the chip on the card. In this way, a single-purpose stored value card remains anonymous as the customer need not identify himself or herself at the time of purchase. However, when the feature is combined with a Visa product, banks can determine the unused value of a damaged card and replace it. Auditability allows financial institutions to monitor and control deposits in the system. In combination, these features add substantial fraud control mechanisms.

Visa is working with central bankers to ensure that the Visa efforts comply with regulations. As the system is accountable and since funds stay in the banking system, Visa has addressed the major issues raised to date. Second, the system uses the common financial industry specifications which will ensure compatibility with other chip-based product applications. Third, the system is designed for simplicity and low-cost operations so that stored value cards can provide a practical alternative to cash and coins.

f. Mondex International

Mondex International Limited, is today owned by 17 major organizations across four continents (North America, Asia, Australia and Europe). The new organization, headquartered in London, will be responsible for managing the future development and international implementation of Mondex.

The first phase of the global introduction of Mondex took place in the UK when the system was brought to market by NatWest, Midland Bank and BT. The 17 participants are: NatWest and Midland Bank PLC (UK); The Hong Kong and Shanghai Banking Corporation Limited(Hong Kong and 12 further Asia/Pacific territories); Canadian Imperial Bank of Commerce and Royal Bank of Canada (Canada); Australia and New Zealand Banking Group Limited, Commonwealth Bank of Australia, National Australia Bank Limited and Westpac Banking Corporation (Australia); ANZ Banking Group (New Zealand) Limited, Bank of New Zealand, Countrywide Banking Corporation Limited, the National Bank of New Zealand Limited, ASB Bank Limited and Westpac Banking Corporation (New Zealand); Wells Fargo Bank and AT&T, through a wholly owned subsidiary of AT&T Universal Card Services (USA).

Leading manufacturers around the world have been involved in the development of Mondex devices, including:

- DNP, Hitachi, Matsushita (known around the world for their Panasonic and Technics brands) and Oki - Japan; ACI, Amdahl, EDS, Motorola, NCR, Unisys and Verifone - USA; BT, Cap Volmac, De La Rue Fortronic, Delphic, Gemplus, Philips, and Siemens - Europe. Altogether more than 250 companies from 20 countries around the world are using Mondex specifications.

- In the UK the current Mondex scheme members are NatWest, Midland Bank and Bank of Scotland. NatWest and Midland Bank are working with BT (British Telecommunications plc) on the Swindon pilot.

- In Canada, Mondex is being introduced by Canadian imperial Bank of Commerce (CIBC), Hong Kong Bank of Canada and Royal Bank of Canada (RBC). Royal Bank of Canada and CIBC, working with Bell Canada, plan to launch a city-wide pilot in Guelph, Ontario later this year.

- In Hong Kong, Mondex is being introduced by Hong Kong Bank. The Hong Kong and Shanghai Banking Corporation Limited has acquired the franchise rights for Mondex in the Far East including China, Indonesia, Macau, Malaysia, Philippines, Singapore, Thailand, India, Taiwan and Sri Lanka.

- In Australia Mondex is being introduced by Australia's four largest banks: National Australia Bank Limited; Westpac Banking Corporation; Commonwealth Bank of Australia; and Australia and New Zealand Banking Group Limited.

- New Zealand's six major banks have agreed to purchase the New Zealand Mondex franchise in partnership with the Australian banks who have agreed to purchase the Australian franchise. Those banks are ANZ Banking Group (New Zealand) Limited, Bank of New Zealand, Countrywide Banking Corporation Limited, the National Bank of New Zealand Limited, ASB Bank Limited and Westpac Banking Corporation.

- In the USA Mondex is being introduced by Wells Fargo Bank, which is the eighth largest bank holding company in the US, providing retail banking in eleven Western states and AT&T, whose credit card unit - AT&T Universal Card Service manages the third largest credit card program in the USA with more than 18 million accounts.

The participants (directly or indirectly) have acquired franchise rights to exploit Mondex in their respective geographical markets and have subscribed for ordinary shares in Mondex International. NatWest is in discussions with a number of other parties who are expected to acquire franchise rights for other markets and also to become shareholders in the company. It is intended that the existing participants will own (following the issue of new ordinary shares in Mondex International to other parties), in aggregate, 76.5% of the fully-issued ordinary share capital of Mondex International.

Recent Mondex's developments include:

- VeriFone Inc., a leading global provider of secure payment solutions, announced an agreement with Mondex which will enable VeriFone to offer hardware and software that is compatible with the new Mondex "electronic cash" payment system. VeriFone's SC™ family of Smart Card system products is expected to allow retail merchant and consumer Mondex Smart Cards to interface and to facilitate digital cash payments for all goods and services currently purchased with coins and currency. VeriFone says that it is the first payment system provider to accept and support the three major international stored value card systems—MasterCard Cash, Mondex and VISA Cash.

- Netex Communications Corporation, a Firecrest Group PLC subsidiary, and Mondex International Limited, signed a strategic alliance agreement that will enable the delivery of global Smart Card applications using the Internet Transphone product. Under the agreement, Netex will develop, integrate and market the 'Transphone' Smart Card based solutions through Netex's current and developing corporate client base and the Mondex electronic cash products.

- Mars Electronics International (MEI) the worldwide vending and unattended point of sale, coin, note and cashless payment systems company has concluded an agreement with Mondex International to develop compatible payment products for vending and other unattended point-of-sale (U-POS) applications.

- Mondex and RINA announced a formal alliance with Mondex International. RINA, as part of Electroland Inc., has been a front-runner in providing computer electronics to Israel for the past 15 years and has been working with Mondex informally over the past 18 months promoting the Mondex proposition in Israel. This agreement gives RINA a formal license to develop Mondex products for use around the world.

- Australia's four biggest banks, ANZ Bank, Commonwealth Bank of Australia, NAB and Westpac Banking Corporation announced that they intend to establish a joint venture, Mondex Australia, to introduce Mondex, the electronic cash smartcard in Australia. Other Australian-based financial organizations will be invited to join the scheme in due course.

- New Zealand's six major banks have agreed to purchase the New Zealand Mondex franchise in partnership with the Australian banks who have agreed to purchase the Australian franchise. Those banks are ANZ Banking Group (New Zealand) Limited, Bank of New Zealand, Countrywide Banking Corporation Limited, the National Bank of New Zealand Limited, ASB Bank Limited and Westpac Banking Corporation.

Mondex is being introduced around the world as an alternative to notes and coins which can be used for everyday shopping as well as for electronic commerce. Mondex will allow banks to transfer electronic cash to and from customers via phone systems as well as ATMs, and will also allow customers to bank and send their electronic cash to other parties using Mondex-compatible telephones.

Mondex UK will extend its trial activity this year with a major university campus launch in Exeter, south west England, where they will explore the use of value-added Mondex features. The initial launches in Canada and Hong Kong mean that they are seeing the commencement of the rapid international deployment of Mondex. Mondex is able to hold several currencies simultaneously as well as offering a payment means for everyday shopping and electronic commerce, thus establishing the framework for Mondex to become a worldwide payment brand with a worldwide ownership.

The various competing smartcards will be accepted by common retailer devices; demonstrations of interoperable terminals from two manufacturers (Verifone & Dassault-AT) at the CardTech/SecurTech conference in Atlanta proved their capability of accepting cards from Mondex and other payment schemes.

The first pilots of Mondex began in July 1995 in Swindon, England (with an adult population of 190,000, situated 100 km from London) where some 10,000 consumers and 700 retailers are taking part; and in San Francisco where over 500 employees of Wells Fargo are able to spend Mondex value at 22 merchant sites including drugstores, coffee shops, bookstores and restaurants. Initial launches are planned to start this year in Guelph, Ontario, Canada (a community of 100,000 situated 90 km from Toronto) and in Hong Kong.

g. CAFE

Conditional Access For Europe (CAFE) has been a project in the European Community's ESPRIT program (Number 7023) that has developed a secure electronic payment system that protects the privacy of the user. Thirteen partners from several countries have been involved. The target was to make electronic wallets that can be used for payment, access to information services, and - if required - identification. It should be an open, secure system. CAFE started in December 1992 and ended in November 1995

The project was about payments in shops, not payments over the Internet. Shop-payments are the more difficult type, because on-line connections cannot be assumed and the hardware must be portable. For the Internet, a system with related properties already exists in real life: Digicash's e-cash.

The main hardware was pocket-sized electronic wallets. Several versions have been designed, some simple with just two buttons, some with larger LCD screens and more buttons. The protocols could also be run in extensions to existing PDAs. The wallets had an infrared interface to make use easier. They use smartcards as money storage. For compatibility, it was possible to use the smartcards without the wallets, although this reduced the protection of users against fake-terminal-attacks and the suitability for multiple applications.

Possible future extensions include electronic personal credentials (like passports, driver's licenses or housekeys) and medical information.

h. NTT DATA

NTT DATA Communications Systems Corporation has recently developed a new IC Card Cashless Payment System. The system employs integrated-circuit (IC) cards that allow cardholders to make purchases on a cashless basis at shops and restaurants located inside a facility in which the system is installed. The system was made available to corporate facilities, universities, and the like in February 1996.

The IC Card Cashless Payment System is essentially a package consisting of the basic features of the cashless systems developed for intelligent buildings. The new system, however, can be installed in just about any facility, at lower cost and in a shorter time.

A feature of the system is that the monetary value of a Smart Card can be replenished by means of a special terminal developed by NTT DATA that allows funds to be transferred directly from the cardholder's bank account to the card. This renders the system completely cashless function (earlier systems required cash to be inserted into the terminal).

i. University of Arizona

The University of Arizona (UA) Smart Card System banking cards may never completely replace pocket money, but a Smart Card can provide an alternative to coins and small bills. While the local arrival of the Smart Card may be years away, a similar program now allows shoppers to use lower-tech cards to make cashless purchases ranging from candy bars to computers. The Smart Card looks like a credit card, but contains a computer microprocessor chip that does far more than regular banking cards can.

The UA's Pocket Money and All Aboard card programs are used each year for $5 million in purchases. The All Aboard card can purchase food at 15 dining facilities and more than 200 vending machines on campus. The Pocket Money card can be used at the campus bookstores, the copy center, the Gallagher movie theater and for campus entertainment and sporting events. 14,000 people have the debit cards.

Students live in UA residence halls, but interest goes far beyond resident students. The account's balance is shown on a cash register viewing screen during each purchase. The popularity and wide acceptance of banking cards are reflected in the growth of the Star System the past 10 years.

The cards work at the University of Arizona in the following way:

- The cards used at the UA are linked to prepaid, replenishable accounts.
- The Smart Card is designed for purchases of less of than $20. For larger purchases, credit cards or checks would be more.
- The card holder can store vast amounts of information on their card. It can accommodate extensive financial records, car and home loan information, and much more.
- The Smart Card requires no personal code number for use, and whoever possesses the card has access to its funds. If you lose it, it is like losing cash - it is gone.

j. Public Access Terminals Ltd.

Public Access Terminals has developed a suite of Windows based products for public and education establishments' libraries, that serve to secure libraries, their stock, streamline administration and to provide detailed on-line management information.

The package enables each registered library member to be issued with a single card that acts as an access control card enabling entry to all library buildings, serves as an identity to pass with the holders photographic image and as the library 'ticket'.

A cashless payment system puts the user in control of when, why and how all their business machines are used and who is using them. Whether they are photocopiers, telephone access systems, fax machines, laser printers, computers, vending machines (the list is open-ended), the user can control and monitor access and cost.

2. *Transactions for Goods and Services--Enabling Technology*

a. Summary

This section describes three enabling technologies.

b. Electronic Payments Services (EPS)

EPS has focused on the settlement side as an essential requirement of electronic purse systems; balancing of accounts between customers, banks, and retailers. Established in December 1992, EPS has rapidly become a leader in automated teller machine (ATM) and point-of-sale (POS) networks.

Launched on February 24, 1994, cards were issued to EPS employees for use in cafeteria, vending machine, payphone, and stamp dispensers. Rollouts were made to corporate headquarters (400 cards), the local township (50,000 cards and 150 merchants), and then state-wide in Delaware (250,000).

The headquarters implementation uses Gemplus 896 chip cards, while the township roll-out used Gemplus MPcos cards. Touch Technology of Phoenix, Arizona was contracted by EPS's Smart Card Enterprise (SCE) business unit to provide the system design, while Danyl Corporation supplied the vending machine technology and the Cash Value Machines (CVMs). The installation includes 9 vending machines, 3 stamp machines, 3 payphones, and the cafeteria. Six CVMs, which dispense cards and can reload value, are located in the three buildings.

The single most important objective (of the headquarters launch) was the employees' familiarity, use, and comfort with the technology. Employee response has been very positive, convenience being repeatedly cited as the biggest benefit. The small vending and cafeteria purchases are very typical of EPS's target market; this card is designed for purchases of under $20.

It should be noted that Smart Card transactions will have to be cheaper than cash in order to be successful, which EPS personnel believes requires an off-line system. Although no specifics were given on pricing, merchant fees are likely among the revenue sources. Smart Card purse systems should be a revenue source, unlike automatic teller machines (ATMs), which initially were an additive expense or overhead for banks.

On the aspects of government regulatory involvement and system safeguards EPS will set up a funds pool that banks will contribute to. The funds are the collateral behind the electronic value on customers cards. EPS is actively working with the Federal Reserve, trusting that regulators are currently watching without the intent to interfere with development, although they are coming up to speed very quickly on the technology.

Privacy will not be an issue if the customers feel that they are receiving value in return for the information collected on their buying habits. EPS believes the market requires audit trails for electronic purse transactions, and that information is one of the most interesting by products of these systems. Frequent buyer and electronic couponing schemes are mentioned as possible value enhancements that will assuage any consumer concerns about privacy.

Management has a strong desire that EPS's system be compatible with any emerging standards, but the U.S. is very fragmented in its approach. It will be 5-7 years before inter-operability is common, except in the phone card market where inter-operability is rapidly emerging as a key criteria.

c. Data Disk

Using its proprietary technology, Data-Disk has developed a data storage system that meets the multiple needs of many emerging applications in the industrial, communications, highly portable computing and consumer electronic markets. This system consists of three integrated elements: the Data-Disk, the Data-Disk Reader, and the system Software.

The technology could change the paradigm of data capture and delivery, replacing dozens of credit cards, securing financial data with biometric authentication, storing digital photographs, recording automobile problems as they occur, and saving time and money by showing service technicians exactly what's wrong.

The Data Disk stores data within an encapsulated linear flash ROM chip. The raw storage capacity of the chip will initially range from 1 megabyte to 16 megabytes. The dynamic compression software described below will increase storage capacity of this chip by at least a factor of five, which equates to 80 megabytes. The Data-Disk is a pin-less device which interfaces with its reader via electrically conductive, direct contact leads that have been encased in tunnels of epoxy. This casing is the feature that makes the Data-Disk weather-resistant and environment-proof. It will come in a variety of form factors to meet specific requirements of various applications and host systems.

The DataDisk Reader is a PCMCIA PC card which provides interface between the Data-Disk and personal computers and networks.

The system software includes a proprietary compression algorithm permitting dynamic compression and decompression, both of which are virtually unnoticeable to the end-user. The compression technique is loss-less; therefore, it is suitable for even the most sensitive applications such as medical, defense, banking and security.

d. OKI

The Oki Value-Checker makes it easy for consumers to verify the balance on electronic purse Smart Cards or pre-paid phone cards. The Value-Checker can also display other information stored on cards, such as health care information, identification numbers, and electronic benefits transfer values. The unit provides handy storage and protection for the card when not in use, and it has a front label that can be used for custom graphics or advertising. The Value-Checker's ultra-thin profile makes it easy to carry in a user's wallet or pocket. Thought the Value-Checker was initially developed for electronic purse Smart Card systems, it can be used in any system where the consumer has a need to view information stored on their Smart Card. Benefits transfer, insurance, pre-paid phone cards and ID cards are some of the other areas where this device could be useful.

3. Passenger Transportation: Reserved Travel

a. Summary

INPUT has concluded from its analysis that there will be two types of VCMS markets:

- For travel that requires making a reservation in advance: "reserved travel" (most air travel, many long distance trains, and cruise ships)
- For travel that is unreserved (an increasing amount of "shuttle" air travel, most short distance and commuter trains, subways, buses)

b. Reserved Travel

INPUT expects that business travel in general, especially that involved in making reservations, will be a target for VCMS in the 1998-99 time frame. Business travel requires the following functions to be performed:

- To authorize travel that is consistent with company policy
- To make the reservations
- To place tickets and related travel documents in the traveler's hands
- To make sure that actual travel was the travel that was originally authorized
- To assist the traveler in completing an expense report for reimbursement of expenses or cash advances
- To review and audit the expense report
- To collect a database of travel actually taken for negotiating with travel suppliers to obtain special rates. (Where individual travelers make their own business travel arrangements, there is the additional need to link payments to travel suppliers with reimbursements to travelers.)

These functions are now being performed by some combination of in-house corporate resources and third parties services (e.g., can be supplied by airlines, travel agencies, credit card issuers, packaged software providers, outsourcers).

- Airline reservation systems are the largest and best known (American/Sabre, United/Galileo, SystemOne/EDS)

- This is a major market for credit card issuers (American Express, Visa, MasterCard, First Bank)

- Major travel agencies (American Express, Carlson) are supplying automated support to their clients to provide differentiation. This is in response to the airlines' desire to deal directly with their major accounts.

At present there is no one source that can support all of a company's travel-related business functions, that is, a VCMS. All of the companies listed above have announced early forms of VCMS, using existing card technology, that will start to link together some parts of the business travel functions.

It should be stressed that these systems are currently incomplete. The main reason that they are incomplete is that these systems do not link, in a consistent and complete manner, actual travel and expenses incurred by each individual traveler. This linkage is now performed by the expense report. Expense reports can be prepared either in a completely manual form or computer-assisted form that requires human judgment in classifying and allocating expenses.

INPUT believes that progress toward integrated travel support will occur in two steps.

- Step 1 will use current magnetic stripe card technology to collect better information on actual travel expenses. However, expense reports will be only partial automated. Step 1 is now underway.

- Step 2 will utilize Smart Card technology to enable individual travelers to use Smart Cards to collect and store the actual expenses of their travel and entertainment expenses. INPUT expects development of Step 2 systems to begin in 1997. Step 2 systems will be true VCMSs. Step 2 will take several years to deploy because of the need to reach hardware and software critical mass.

The opportunity in Step 2 is large. U.S. companies spend approximately $150 billion on travel and entertainment expenses. This represents a very large opportunity for a travel expense-oriented VCMS.

Note: INPUT has made available to NTT DATA CORPORATION a full analysis of the Travel Smart Card.

c. Unreserved Passenger Travel

INPUT's analysis for this study has shown the similarities of Smart Card and VCMS applications for unreserved passenger travel and applications for vehicles.

- Both involve very large numbers of relatively small transaction
- In both cases the value is collected for a trip (or trips)
- Both occur in controlled settings
- In both cases, the costs of collection are a relatively high proportion of total costs.
- Bottlenecks in the payment and ticket collection process (at toll gates or at wickets/turnstiles) cause customer dissatisfaction and add to provider costs.

There are differences:

- Vehicle VCMS systems will almost always use contactless cards
- Passenger systems may use either contact or contactless cards (or hybrids)

The technology and applications appear similar to those used in vehicular transportation (which is addressed in Chapter V, below).

4. Unreserved Travel & Vehicle Tolls

a. Summary

This chapter describes applications, vendors and the special issues of congestion control and economically-oriented VCMS applications for vehicles.

INPUT believes that the immediate opportunities lie in providing VCMS for unreserved passenger travel and vehicle tolls. The business characteristics as well as many of the technical characteristics of these VCMS systems are quite similar.

b. Applications

(1) Duncan Industries

Duncan Industries 'Cashless' Datakey Solution is reducing vandalism and theft and the high costs of theft, security, and coin counting time for parking meters.

Parking meters are installed in unprotected outdoor environments, making them especially vulnerable to vandalism and theft. Moreover, the costs and security risks associated with collecting and counting large amounts of coins provides an additional challenge for the municipalities that depend on meters for revenue.

The customer, Duncan Industries, is one of the world's leading manufacturers of parking meters. Duncan's search for an alternative to cash sought to address the following goals:

- Discourage meter vandalism and theft
- Reduce costs associated with coin collection and counting
- Reduce security required at the meter site and the coin-collecting site
- Make meters easier to use

This cashless parking meter uses a special designed data key to ensure reliable electronic payment transactions in outdoor parking environments where the device is exposed to extreme weather and rough handling. Duncan contacted Datakey to develop a custom data carrier that would perform reliably in the demanding outdoor environment of parking meters.

The jointly developed product, which Duncan calls the CashKey, works this way. The data keys are programmed with a prepaid amount of electronic credit. The driver inserts the key into the meter, and the appropriate amount of parking value is deducted. When the credit in the key is used up, it can be replenished via a special payment terminal at local convenience stores. A microprocessor in the key provides security and control over all key transactions.

After being contacted by Duncan, Datakeys engineers melded Duncan's experience in portable data carriers with Duncan engineers' parking meter design experience. The result was a custom device that employs a completely new type of key and receptacle contact design that can handle the exceedingly high volume of repetitive insertion cycles demanded by the application. The design had to have an extended life of over 200,000 cycles -- this translates to a total movement across the contacts of over four miles!

After extensive field testing, Duncan has now installed its CashKey meters in several cities around the world. The Datakey solution brings significant advantages over either cash or a magnetic stripe card, including the following:

- Increased Security. Because the transactions are cashless, the associated theft, vandalism and security risks are virtually eliminated.
- Decreased Costs. This cashless solution also eliminates the need for coin collection and counting, saving both money and time.
- Increased Customer Convenience. Drivers no longer need to carry or fumble for correct change. Unlike a magnetic card that the driver keeps in a wallet, the data key stays on a keychain -- something the driver already has out anyway.

- The keys are also easy to use in all types of weather conditions, even when drivers are wearing gloves, for example.

- Increased Durability. The sturdiness of the data key makes it an especially appropriate device for withstanding harsh outdoor conditions.

The parking meter application has markets worldwide. Expected production volume for this Datakey product could run into the millions.

(2) Citibank

CitiCard's system is equipped with parking products tailored to the customers needs, ranging from short- to long-term parking. The use of various value card options and cashless payment facilities enable complete targeted marketing. The system incorporates comprehensive customer administration for easy management. Car park pools and CityCard options can be easily integrated The lowest installment and maintenance costs, the easy repair of failures, the anti-fraud system against manipulation of any kind, and extensive guarantee regulations ensure this system's rapid amortization.

(3) E-ZPass

E-ZPass is New York's Smart Card solution to bridge and tunnel tolls in the metropolitan region. E-ZPass is a complex VCMS system involving the end user, the Triborough Bridge and Tunnel Authority, and a credited entity (a company in the case of large users or a credit card issuer in the case of small or individual users.

- Subscribers prepay the BTA or authorize the Bridge and Tunnel Authority to charge a specified dollar amount to the user's credit card. The BTA issues a Smart Card which the driver places on the dashboard of the vehicle.

- As the user passes through a toll plaza the Smart Card transmits its identifying information over a radio frequency. The information is captured at the booth and transmitted to a central management system.

- The transaction is logged and the subscriber's account at the BTA is debited.

- When the user's account for the Smart Card gets to a certain minimum level, the system automatically invoices the large user or extracts a pre-authorized amount from the credit card issuer. The subscriber's record is updated with the new account balance and the process repeated.

After discount tokens are eliminated, in early 1997, the authority is expecting that 50 percent of bridge users will be on E-ZPass. By 2001, the prediction is 60 percent. The predictions are based on market surveys conducted last year, questioning both regular and occasional

bridge users, and the fact that 45 percent of bridge and tunnel travelers use tokens. So far, 145,000 E-ZPass tags have been sold. The goal is to sell 440,000.

(4) SAIC

The transportation industry is being revolutionized by advances in information systems and inspection technologies. SAIC, a large systems integrator whose primary marketplace is national governments, is helping to shape that revolution by developing new methods to move people and goods faster, cheaper and more safely. Transportation is one of SAIC's fastest-growing business areas. Their success has been based on their ability to increase efficiency, improve safety and enhance mobility for the world's transportation systems.

SAIC's most powerful recent improvements to transportation management include:

- Toll collection systems
- Equipment identification and shipment management systems
- Transportation and traffic management systems

SAIC's Syntonic subsidiary is an expert in computerized toll collection systems, having installed toll roads in North and South America, the Pacific Rim and Australia.

Last year SAIC acquired TST International, an Australian manufacturer of toll collection equipment that supplies the fast-developing transportation markets of Southeast Asia. Syntonic recently installed, tested and activated the 34-lane electronic toll collection system for the Dulles Greenway Tollroad to Washington's Dulles International Airport. This record breaking project, accomplished in only 120 days, included the first use of credit cards on a U.S. toll system.

JHK & Associates, an SAIC partner, is a leader in intelligent transportation systems, including traffic and systems engineering and transportation planning. Syntonic develops, installs and maintains automated toll collection systems and software.

c. VCMS For Congestion Control

There are few technical reasons why vehicle VCMS toll systems could not be extended to control access to city centers and other congested areas. Singapore is implementing for such a system, with Smart Card readers placed at "checkpoints" to charge for access to certain districts.

However, INPUT believes that the Singapore scheme is an exception and that there will be very few similar schemes proposed in the next ten years for the following reasons:

- Vehicle tolls are accepted now because the facilities are announced and built as fee-paying facilities. There are generally no-charge alternatives for those who prefer not to pay the fee.

- Congestion charges are very logical, but are offensive politically: They are viewed by the public as an attempt "by the politicians" to take away something that has always been "free". The interest groups who would be most affected by these changes (trucking, taxis, business drivers) are well connected and can channel public feeling.

Singapore is an unusual state in that it is rich enough to have traffic congestion. but also is an authoritarian, logical state. Public opinion plays a much less important role in Singapore than in other democracies. Thus, in INPUT's view, Singapore is the "exception that proves the rule".

d. Vehicles: Economic-Oriented VCMS Applications

In principle, a Smart Card could be embedded in every vehicle that would uniquely identify a vehicle. Various VCMS applications would be possible:

- Vehicle registration
- Parking and traffic violation, and accident histories
- Insurance certification
- Interface between required safety inspections and on-board monitoring systems
- Identification of stolen vehicles

In the U.S. there is now a specialized commercial service that uses a form of VCMS for the recovery of stolen vehicles. Vehicles covered by this service, Lo-Jack, are fitted with a special radio transmitter whose signal is tracked when the owner reports the vehicle missing. This system does not use the type of Smart Card generally associated with the VCMS's analyzed elsewhere in this study.

- However, the application principle is the same.
- Equally important, vehicle owners are willing to pay $500 - $1,000 for the service. This shows that fees can be quite attractive where a VCMS-type service fills a perceived need

The other, wider types of vehicle-oriented VCMS's will probably not occur until there is widespread penetration of toll collection-oriented VCMS, in INPUT's opinion.

5. Health Applications

a. Summary

Smart Cards provide a convenient and secure medium for storing medical information. Medical applications of Smart Cards can be divided into six broad categories based on the type and amount of information being stored:

- Insurance Cards - Containing ID and policy information.

- Emergency Medical Cards - Containing medical and contact information tailored to the needs of emergency medical personnel.

- Hospital Admission Cards - Containing comprehensive insurance and demographic information.

- Follow-Up Cards - Tailored to store medical data for specialties such as: Cardiology, Diabetes, Dialysis, Maternity, Oncology, Pharmacy, and Pulmonary Medicine.

- Universal Health Cards - Containing insurance ID information, key demographic data, and links to the patient's medical record.

- Health Passport Cards - Containing comprehensive medical and insurance information.

France has devoted the resources to create a sophisticated health insurance payment system that assures data confidentiality, integrity, authentication, and security. It includes features that are only provided by Smart Card technology, such as built in encryption and electronic signature abilities. They are currently piloting this microprocessor-chip Smart Card system in four French cities.

Germany chose to develop a more basic system than France's. It uses very inexpensive 256-byte memory cards. Since theirs took less time to develop, the German system is now fully implemented, and the entire population of nearly 80 million Germans is carrying the cards.

- The main concerns addressed by the German system are patient identification and the elimination of duplicate records. The data being stored on the German Health Insurance Card consists of the ID of the insurance and the insured person, his/her name and address, date of birth, and the status and date of expiration. This could have easily been done with magnetic stripe technology.

- Instead, Germany found that chip cards were less expensive when they considered how quickly the magnetic stripe card infrastructure would have to be replaced or supplemented with the equipment necessary to communicate with Smart Cards.

Any time medical information is stored electronically there is concern about patient privacy. While a security breach of a clinic using paper records might involve hundreds of records (i.e. all the information that a person might carry out), a security breach of electronic medical records might involve hundreds of thousands of records, and go unnoticed. However,

- Card backups assure that the Smart Card system offers the same level of convenience as any other. If cards are lost or stolen, they can quickly be replaced. (And if a card is stolen, the thief can't use it or read any sensitive information from it because it is password protected.)

- There is an enormous difference between relying on Smart Cards as the primary source for data, and relying on a remote on-line source. Since Smart Card backup information is only accessed when cards require replacement, very high security measures can be put in place without affecting the flow of information in the system. There are many other benefits that come from the fact that backups in a Smart Card system can be batch transmitted, minimizing system telecommunication costs.

A need has developed where hospitals and healthcare organizations to integrate information systems from different vendors and between vendor systems and in house developed systems. In response to this need an HL7 Working Group was organized in March 1987.

HL7 Working Group is a group of volunteers who give their time on a personal basis or under sponsorship of their employers. They have been meeting every 3-4 months since March 1987 to develop and review the interface specifications. They have developed standards to address interfaces that send or receive patient admissions/registration, discharge or transfer (ADT) data, queries, orders, results, clinical observations, billing and master file update information. The term 'Level 7' refers to the highest level of the Open System Interconnection (OSI) model of the International Standards Organization. In the OSI model the functions of both communications software and hardware are separated into seven layers or levels.

- The seventh level refers to the application level. The application level defines the physical format of a message, or the location of the actual fields of each electronic message.

- Health Level Seven (HL7) is an application protocol for electronic data exchange in Healthcare environments.

- In June 1994, HL7 became an ANSI Accredited Standards Organization (in addition to participating in ANSI's Health Information Standards Planning Panel (HISPP)).

- HL7 was deemed the method of choice for an application protocol to carry out electronic data exchange at the University of Michigan Medical Center.

b. Applications and Vendors

(1) Berdy SmartCard

The Berdy SmartCard looks like a credit-card. It stores an individual's medical record on a thumbnail-sized computer right on the card. The doctor and hospital read and write the patients medical information using a computer system which they provide. Patients determine what information will be stored on the card, and who will have access to the information.

The Berdy SmartCard benefits include: portable, confidential, secure, convenient, and durable. It enables patients to carry their medical record information wherever they go and share it only with those the patient chooses. It holds elements of medical records required when visiting a

new physician for the first time, registering for care in an emergency room, or being admitted to a hospital.

The Berdy SmartCard can hold the following information:

- Clinical Snapshot. Summarizes the vital medical record information caregivers need in an emergency: an overview of current and chronic problems, allergies, current medications, blood type, and family physician contact information.

- Demography. Basic data about the holder such as address, phone, date of birth, marital status, occupation, employer, and next of kin name, relation, and phone number.

- Medical History. An extensive profile of past illnesses, medications, procedures, plus recent physical examination and family medical history.

- Insurance. Information on the parties responsible for payment of your healthcare services.

(2) Medi-Tag

The Medi-Tag can be carried either on a key chain or around the neck, and is designed to provide emergency medical information at the point of care.

The stored information can include such detailed data as X-rays, MRIs, signatures, fingerprints, eye scans, pharmaceutical, allergy and immunization information, dental records, basic descriptions of one's surgeries or other relevant medical information.

The Department of Defense (DOD) has placed a priority on maintaining the integrity and reliability of combat care information. In recent conflicts, including "Desert Storm," medical record information was frequently lost when injured combatants were transferred from the battle zone to Mobile Army Surgical Hospital (MASH) units and to stateside hospitals.

- Pen-and-paper records did not always travel with the injured, nor did they always survive battlefield environments. When the paper records did survive, they were frequently illegible.

- The DOD has spent millions of dollars and ten years of research and development investigating hardware and software solutions to meet the need for medical storage systems in battlefield environments. To date, no solution has been accepted or deployed because no solution has been found to survive the harsh conditions of the mobile military environment. Medi-Tag technology meets this need.

As part of the DOD's technology investigation in 1995, the Medical Advanced Technology Management Office (MATMO) spent $150,000 to demonstrate the Medi-Tag concept and display the existing working prototype. The Company plans to capitalize on the success of its prototype by completing its commercial development and subjecting it to field tests.

- MATMO has indicated that if the Medi-Tag meets the environmental requirements of the field validation tests, it will recommend to the U.S. Secretary of Defense that the Medi-Tag be adopted as the standard technology for medical tags to be used by all U.S. soldiers.

- Benefits include carrying complete individual medical history on a key chain - up to 40 thousand pages, including dental records, X-rays, MRI's, EKG's; storing and accessing more data at remote locations using palmtops, subnotebooks and personal digital assistants.

(3) Health Card Technologies

Health Card Technologies, Inc., was formed by a medical application developer and a Smart Card manufacturer to meet the need for on-hand medical information.

DataCard 280 Series card personalization system offers card issuance solutions from patient IDs, to credit, debit and ATM cards. It can:

- Be adapted to any computer platform
- Assure the identity of patients
- Verify insurance coverage
- Secure payment for health services
- Produce an audit trail for fighting fraud
- Help physicians, pharmacists, and patients track medications

HCT has expertise in all types of Smart Card systems:

- Contact microprocessor chip
- Serial memory
- Controller embedded PCMCIA flash memory
- Contactless radio frequency identification (RFID)

(4) CHAT

CHAT has entered the 21st century in animal identification with its Identification program. AVID® Microchip is a tiny computer chip that is inserted under the skin of the cat and it remains there safely throughout the cats life.

An Identification number is programmed into the chip, and this provides permanent identification of the cat that cannot be lost, altered, or removed. It does not migrate in the animal's body. No two animals will ever have the same number.

An AVID® scanner reads the number on the chip. AVID® has donated these scanners to every humane society, animal shelter, and animal control agency throughout the nation. CHAT also has a scanner. AVID® has a national computerized network that will notify the owner directly if their cat is found.

The microchip can be implanted during a regular vaccination visit. No anesthesia is required. It is given just like a normal shot.

6. *Government Applications*

a. Summary

The government applications described in this chapter involve identifying citizens who are receiving various types of government services, primarily social services and employment-related services. In principle, these functions could be combined on a single, all-purpose national identification and services card. However, INPUT believes that this will be very hard to accomplish politically in most countries that are technologically advanced.

The Social Security Number (SSN) is often seized upon by record keepers as the simplest scheme of identification. The SSN has been put forth as the health identification number by policy makers at all levels and branches of government. The SSN is currently recommended for use in health information systems in some states. The Social Security Number is used by federal agencies, state motor vehicle departments, the selective service, educational institutions, and numerous private sector businesses. Despite its widespread use, the Social Security Number fails all of the requirements for a unique identifier. More importantly, the use of the Social Security Number is a threat to personal privacy and confidentiality and undermines system security and reliability. In addition, the initial draw towards the Social Security Number is based on the false assumption that it can be used within health information systems without informing individuals and gaining their consent. The statutory and case law history of the Social Security Number runs strongly counter to this assumption.

Social Services Recipients/Photo Identification directs HRS (Health and Rehabilitative Services) & AHCA (Agency for Health Care Administration) to establish fingerprint matching identification system and photo identification card for recipients of:

- Food stamps
- Aid to Families with Dependent Children
- Medicaid

- Provides for determination of duplicate enrollments for benefits
- Provides for notice, verification, & termination of benefits;
- Provides for review & amendment of data in identification system;
- Provides for periodic system audits, etc.

Information from medical records may influence credit, admission to educational institutions, and employment. It may also affect your ability to get health insurance, or the rates you pay for coverage (OTA report). More importantly, having others know intimate details about your life may mean a loss of dignity and autonomy.

b. National ID Card Initiatives

(1) National Institute of Standards and Technology (NIST)

NIST/Mitre Public Key Infrastructure study addresses national and global issues in order to facilitate the interoperation of protected electronic commerce among the various levels of government in the U.S., private citizens, commercial organizations, and international organizations. A system which put all federal employees online with an authenticated e-mail/EDI system would cost $10.8 billion a year.

- Cost per message of $.15.
- Cost per user from $156 to $5,043 per year.
- Confidentiality options: RSA and El Gamal/DES and public key combinations. (El Gamal - a public key encryption algorithm used for authentication; it is quite similar to DES.)

NIST's SCAPI

- Developed by DARPA, NIST, DataKey and Trusted Information Systems Inc.
- Hardware independent API for smartcards
- Implemented in software only, or hardware/software
- ISO reader/writer
- Tested with Hitachi Smart Card
- Bytes of RAM

- KROM - (Kilobytes of read only memory)
- K EEPROM(public key stored here)

NIST is already experimenting with:

- IRS for tax filing (Currency Transaction Reports, TAXLINK withholding, Direct Electronic Access)
- Patent and Trademark office for patent applications
- FAA for airmen medical certifications
- Defense Logistics Agency, electronic bids
- NASA for financial transactions
- USPS (United States Postal Service) is considering the offering of certification services to the general public (Electronic Postmark [EPM] and EPM-Plus, sig + time stamp)

(2) The National Health Board (NHB)

NHB is responsible for assuring unique identifiers cannot connect individual health information with other individually identifiable information from other sources. Data on the card includes name, subscriber number, payer name, payer number, plan/contract number, claim submission address and phone number.

NHB contracted (for $35,000) with Los Alamos National Labs to explore 'Personal Access Kiosks', an ATM-like terminal for accessing Social Security records. All communications use number not name, so identification should be possible only through access to a subscriber database.

(3) U.S. Department of Defense (DOD)

The Petaluma, CA ID card office can issue cards to all military and dependent members of the Department of Defense (DOD).

(4) Welfare Benefits

Debit cards are being used to prepay many services and products. A number of state and county organizations are using Teraco magnetic stripe debit cards to take the place of food stamps and other social service benefits.

(5) OPUS

The OPUS System is designed to replace an existing computer system as the means of managing over 26,500 inmates and more than 105,000 probationers and parolees assigned to the custody of the Department of Correction.

(6) AND Identification

In 1992, AND Identification was founded to develop an electronic system for fast, secure and fraud proof border control. Within a year, the new business unit perfected storage of the fingerprint on a Smart Card. A new identity document was born, offering optimal security against any form of fraud. The new additional passport became operational at Schiphol airport, causing other national governments to show interest in developing similar systems.

Today, AND Identification acts as an independent integrator in complete projects for all kinds of electronic personal identification. In a project AND acts as a technology provider or as a total project manager managing all activities on both hardware and software.

As personal identification becomes an important issue in international markets, AND Identification puts effort in research and development in order to provide organizations with the latest techniques and products. These vary from biometric verification (such as fingerprint scan and hand geometry) and system design to network security and universal (smart)card interfaces. This broad field of expertise and the highly qualified staff of AND sets a standard for contemporary electronic identity documents.

Using the internationally acknowledged AND Identification systems, quick, safe and user friendly electronic identification for border control, access control and computer access is now a reality.

Main border passages in Europe and the Far East handle large volumes of crossings a day. In order to automate the checking process, Identification developed in co-operation with immigration authorities a system based on Smart Cards and fingerprint identification for fast and safe border control.

Under the authority of the Dutch Justice Department, Smart Card technology was used to provide refugees applying for political asylum in the Netherlands with a temporary identification document. This Smart Card enables registration at local immigration offices. Today, several of these systems are operational at refugee centers all over the Netherlands.

Using the full potential of Smart Card security, AND's SmartLogin offers network users sophisticated protection for their information. It gives unrestricted access to general files, but requires use of a Smart Card to gain entry to any classified material.

(7) Singapore Tourism

The Singapore Tourist Promotion Board is looking at launching a tourist Smart Card by next year.

The stored-value card, which will be made available to tourists both locally an internationally, will allow them to engage in cashless transactions for admissions to attractions, retail purchases and facilitate the goods and services tax refund.

The concept has been well received by the industry, says an STPB spokesperson.

(8) Other

A number of governments are in the process of planning or testing cards and VCMSs to identify and authorize social welfare benefits. These already come close to being a form of national identity card. An extension of this would be special forms of VCMS to manage people arrested, on probation, etc. These uses are very controversial, but could become acceptable for controlling immigration, etc..

Voting has not been piloted, but is a logical outgrowth of Identity.

Criminal justice would be the next stage of the "electronic handcuff" in wide use in the U.S.

7. High Volume Specialized Services

a. Summary

The two high volume applications identified are prepare telephone cards and gaming VCMS. Both of these require a high degree of security, which can be built into the Smart Card.

b. Telephone

Popular in Europe and Asia for over 19 years, prepaid phone cards are beginning to catch on in the United States and are fast gaining popularity as an effective component in the US promotional marketing arena. These disposable and rechargeable cards offer consumers free long distance time and will be used in several major high-profile consumer promotions over the next year.

The cards can be produced in colorful promotion or plain versions. Printed on these credit card sized cards is an 800 number which accesses an intelligent network database. A voice prompt instructs the user to input a personal identification number (PIN) which is printed on the back of the card. The database recognizes the phone from which the call originates, validates the card's access code and relays to the caller how much value remains in the card. In other words, users dial an 800 number, punch in identification numbers and 'spend' the time. Phone calls can be used from any touch-tone phone in the United States.

If used as a promotional medium, the promoter may include in the dialing process two seven to ten second promotional/commercial or other specific messages providing the ability to communicate anything desired to existing or potential customers.

- Prepaid telephone cards are an effective promotional advertising medium for many reasons including the following:

- Phone cards can easily and inexpensively reach a wide cross section of existing or potential customers

- Two 7-10 second audio messages enable customized communication focused directly at customer or to communicate Company information to salesmen or employees.

Phone Cards can be used as a premium included with direct mail promotions, as employers incentives, or as gifts.

- Phone Cards have the lowest cost of any comparable customer premium.

- Cards can be used by the customer anytime, anyplace for long distance calls.

- Phone Cards represent a premium that anyone can use (almost everyone uses long distance, every day).one can insert them into vacation and welcome packages.

Sales representatives use them at trade shows and as customer premiums.

Corporations sponsor phone cards at charity events that reward charities when time is used by patrons for long distance calls.

Through strategic relationships with the major long distance carriers and other service providers, the Company can offer its users of long distance prepaid cards significant savings as compared with long distance credit cards.

- A continuing frequent caller program can open new channels of customer acquisition and loyalty.

- Cost conscious companies use them as budget control items for outside salesman and employees to contain long distance costs.

CP&D CP&D Interactive Systems, Inc. provides a comprehensive service for the design, development, implementation and management of all types of interactive communication systems using prepaid telephone cards. The three main components of service are:

- Collectable Phone Cards

- Prepaid telephone cards.

- Promotional and incentive based
- Retail
- International origination
- view Sample inventory
- Order Price List
- View latest card

- Business and enhanced services
  - Audio, Audiographic and Video conferencing
  - Direct Product Sales
  - Dealer Locators
  - Cash/Smart Card

c. Electronic Couponing/Loyalty Cards

These are both high-volume activities conducted by most of the major supermarket chains in the U.S.

(1) Electronic Couponing

Electronic couponing is a separate system that is programmed to produce a coupon for a competitive product in response to products that have been scanned during the cashiering process. Couponing may also be tied to a store database of customer activity which will analyze overall buying patterns.

Electronic couponing is more efficient than direct mail coupon or advertising inserts. However, like all couponing, the efforts of different packaged goods manufacturers tend to cancel out.

There would be advantages to having a consumer's buying history entered into a Smart Card: Promotion efforts could be further tailored to particular buying patterns. However, INPUT believes that because of the competitive nature of the supermarket, mass merchandising and packaged goods businesses it would be difficult to obtain the industry-wide cooperation to make this attractive.

(2) Loyalty Cards:

A specific merchant already has a database of purchases for a particular consumer who uses its loyalty card (although often this is only kept at the level of an individual store). The fact that most supermarkets do not know what to do with all of the information they have collected for their own customers means that there would be little current support for an industry-wide initiative. Unless the great majority of stories took part (i.e., agreed to load the Smart Card with detailed purchase information), such an initiative would not be effective

For these reasons, INPUT does not see couponing or loyalty card VCMSs as an issue for at least three more years.

d. Gaming

The gaming (gambling) industry represents an immediate opportunity for Smart Cards and VCMS for replacing cash and plastic chips, while at the same time gaining more management control. Smart Cards may increase gambling establishments' revenues. The following vendors are active in this industry:

- DataCard has developed a card production system for use by casinos. The system allows casinos to print bar codes, encode magnetic strips, and personalize smart card chips. The cards may then be used for access control, credit and debit programs, player tracking, cashless gaming, and other automated applications.

- Coms21 provides a control management system, Key Control, based on smart card technology. The core of the technology involves the use of numerous microprocessor boards which are each able to control one or more devices such as security sensors and slot machines. These systems are also capable of communicating with an integrated paging application and of providing electronic storage of visual images, both functions that have the potential to contribute to more control over the play of games.

- CardLogix's Cashless Gambling smart card acts as a closed monetary instrument for monetary exchange. The card is loaded and through software protocols and customized cryptology. The card may also be used for interactive played benefits such as additional slot machine pulls, free drinks, and so on.

8. Economic Exchange

One form of managing "congestion tolls" (discussed above) would be to issue a "congestion" Smart Card to all drivers in a region with a value of, say, $100. Drivers could use the VCMS to buy, sell and trade these rights. As indicated in the prior section, INPUT does not believe that congestion control itself will become politically acceptable anytime in the near future.

However, there may be more immediate opportunities, at least in the U.S., for a system for trading the "right to pollute" the environment. This has been legally allowed for three years. Trading pollution rights is still done on a small scale because:

- While legally permissible, corporations are still not sure of the public acceptability of the practice.
- There are still some questions of legal liability
- There is no simple way to match buyers and sellers

INPUT believes that a VCMS could prove the best way to match buyers and sellers. There would be a relatively small number of customers, but this would be a high vale added service -- there would be a relatively large amount of consulting advice and systems integration that would be part of this service.

INPUT believes that it will be 2-3 years until this represents a commercial opportunity in the U.S. INPUT is not aware of any other major industrial country that allows the "trading" of the right to pollute, although it has been widely discussed.

9. Product Warranty

Smart Cards have been proposed as a replacement to product barcoding, following a product through the distribution process up to the point of retail payment. This replacement will not be economically feasible for some time because of the current costs of Smart Cards, related hardware and the costs of changing software and procedures.

However, INPUT is aware of proposals to use a product-attached Smart Card as part of the warranty and service process. The service record and instructions would be incorporated into the Card. If Smart Card use were extended, this could be used as part of the justification for replacing the bar code. An advantage is that this use of a VCMS could be introduced by an individual manufacturer and would not necessarily be dependent on agreement by an entire industry.

INPUT believes that this type of VCMS is at least two years away from introduction.

(Note: INPUT is unable to disclose more detailed information due to client non-disclosure agreements.)

B. VCMS Classification and Analysis

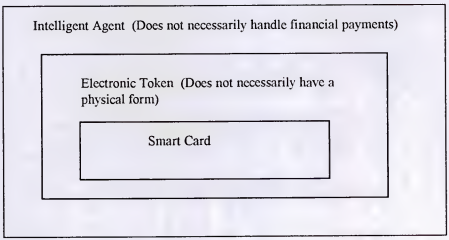
1. Overview

The VCMS market and VCMS development in most industry/applications areas are both in early stages of maturation where the emphasis is one conceptualization, planning, pilot trails, and limited implementations. The direction, speed of growth, and size of the VCMS market will be driven by the needs of the particular industries, applications, or geographies. A critical variable dictating much of VCMS' future is acceptance of these systems by consumers and/or employees. While technological developments are important, these will be secondary to the (perceived) utility of the individual VCMS applications.

It is useful to view Smart Cards on a continuum which includes Intelligent Agents and Electronic Tokens (see Exhibit 2). An electronic token is an object that a user carries to hold his/her valuable information or authenticate his/her identity. This information, which may be encrypted on a device or in software. If read by a reader for a specific Smart Card, the embedded information accessed and/or changed, depending on the level of intelligence of the card.

Exhibit 2

Hierarchy of Agents, Tokens and Smart Cards


Intelligent Agent (Does not necessarily handle financial payments)
Electronic Token (Does not necessarily have a physical form)
Smart Card

a. Summary

The VCMS market is in a very early state of development. VCMS development in most industry/application areas is in early stages: Concept, planning, implementation and pilot trials. a) electronic tokens are not always used for financial payments, b) intelligent agents do not usually have a physical form, c) smart cards are not always used for financial payments (e.g., can be used for medical records, access, etc.)

There are many, many variables that will influence the direction, speed and size of VCMS markets. INPUT's analysis suggests very strongly that VCMS will be driven be the needs of particular markets. Some of the drivers will be specific to an industry or application. In other cases, certain countries or geographic regions may be ahead or behind others in the same application area.

Most decisions regarding VCMS will be made by businesses (including governments). However, a VCMS will have to be used by individual consumers or business employees. In some cases the acceptance or attractiveness of a VCMS by consumers or employees will be critical to the success of a VCMS. Technology is important, but usually less of a determining factor than the perceived utility or attractiveness of a VCMS application.

2. Classification of VCMS

INPUT classifies VCMS into the following general categories:

- Simple VCMS (value on card only)
- Intermediate VCMS (value on card; central knowledge and control)
- Complete VCMS (interactions between multiple VCMSs and customers)

Exhibits 3 and 4 only contrast the "simple" VCMS with "intermediate" (3 types) and "complete" VCMS (3 types).

Exhibit 3

VCMS CLASSIFICATION

SIMPLE AND INTERMEDIATE VCMS

VALUE STORAGE LOCATION	REMARKS	CATEGORY/ SUB-CATEGORY	EXAMPLE
Card only	Network serves as communications vehicle. The values collected by the VCMS are not linked to a particular user or card	Simple	Telephone cards
Card (Primary)	The most complete set of data is on card	Intermediate 1	Proton
Card and Computer	Card and computer system contain very similar (duplicate) data	Intermediate 2	Gaming cards
Computer System (Primary)	The most complete set of data is in computer system	Intermediate 3	Contactless vehicle toll cards (e.g., E-Z Pass)

Exhibit 4

VCMS CLASSIFICATION

COMPLEX VCMS (Interactions of Multiple VCMS)

VALUE STORAGE LOCATION	REMARKS	CATEGORY/ SUB-CATEGORY	EXAMPLE
Card (Primary)	The most complete set of data is on card	Complex 1	Travel Smart Card-Step 2 (future)
Card and Computer System	Card and computer system contain very similar (duplicate) data	Complex 2	VisaCash
Computer System (Primary)	The most complete set of data is in computer system	Complex 3	Travel Smart Cards-Step 1 (current-generation, e.g., American, AmEx)

a. Simple VCMS

The value is only stored on the card. For this type of VCMS device the direction has been changing the nature of the card (e.g., contact to contactless) and its capacity. Examples of these developments follow.

- Racom Systems Inc. & Rohm Co. Ltd., formed a multi-million dollar partnership to manufacture ferroelectric chips that are battery free. These are slid over a radio wave antenna on a kiosk and are used for electronic ticketing, automatic fare collection on buses, subways and trains, electronic point-of-sale, electronic benefits transfer. So far there are 100 installations world wide.

- Siemens Components produces a microchip that combines radio frequency and stored-value functions on a single card.

- Ramtron developed a memory technology, called ferroeclectric random access memory (FRAM), which utilizes complex molecules to store bits of data as the position of an atom within a crystal lattice.

- Meinen, Ziegel & Co. GmbH of Munich, Germany has developed a fully automatic cold manufacturing technology for the mass production of contactless Smart Cards. Meinen, Ziegel is a leading equipment designer and manufacturer of advanced card production and inspection equipment. They can configure either semiautomatic or fully automatic contactless

card production lines, including chip module and coil implantation, for any volume of card production. An antenna coil winding and welding process to connect the chip module with the wire ends of the coil can be included. Their unique manufacturing techniques are being offered to all card manufacturers in an effort to build-up the marketplace.

The market for contactless Smart Cards (also known as proximity or RFID cards) is growing rapidly. Market analysts project more than 100 million of these cards by 1998. Automatic fare collection, access control and electronic purse systems are driving the market for contactless Smart Cards. In a contactless Smart Card, the chip is completely embedded in the card. Data is exchanged between the card and a card reader over a certain distance via a radio antennae.

Until now, embedding electronic assemblies in cards while maintaining a quality smooth surface finish has not been a simple task. Previously, the traditional technology has included a hot lamination or molding process. In a thermal process, it is very difficult to achieve an absolutely smooth surface suitable for low cost direct-to-PVC dye sublimation printers that are readily available today.

However, using the new Meinen, Ziegel process, card manufacturers are capable of producing true ISO thickness cards (0.030") suitable for quality photo imaging. Most important, the Meinen, Ziegel technology avoids all the disadvantages of the more traditional thermal processes. All types of plastic material can be used with various electronic components, including chip modules and coil antennas as well as PCB-type assemblies.

Meinen, Ziegel also offers Smart Card production equipment for contact cards in which the chip is implanted onto the card surface for interfacing directly with card read/writers. Their in-line production systems integrate all essential Smart Card processes, including milling, chip implantation, and bonding, as well as optional testing & encoding, ink-jet and/or laser personalization, and even card packaging. A patented cold liquid bonding technology is offered in addition to the more traditional hot-melt process. For superior bonding strength, particularly required for processing microprocessor chips, the cold liquid adhesive process has proven itself in many applications around the world. Other equipment offered by Meinen, Ziegel includes high-volume encoding and personalization systems comprised of multiple contact heads for parallel processing. (Royonix Inc. is the exclusive North American distributor of Meinen, Ziegel & Co. smartcard manufacturing systems).

Memory functions are key components of Smart Cards. Recent additions to functionality include: access control, account debiting, and data storage. Generally cards are functionally described as read only, add only, modify or erase, and no access. These various functions come from the type of memory included on the card. A taxonomy is provided below:

- Volatile
- Nonvolatile: ROM, EPROM, Flash memory, EEPROM

With value stored only on a card, there is a chance of customers using the token multiple times. This limitation is being addressed.

- An e-cash system such as Digicash, the consumer actually holds the digital cash on his or her personal computer (PC) and transfers it to the merchant. With this scheme, the person who spends one of its electronic tokens does not need to reveal his identity to the buyer, or to a third party. If the digital money is indeed presented for payment twice then the token will yield up information enabling the person with whom it originated to be identified.

- Mondex has a similar card where the digital cash resides on the Mondex Smart Card instead of on the PC. They have developed a connection that links the portable Mondex card readers with a PC via the computer's serial port or parallel port.

- Most technologies are in beta or early alpha testing but the overall theme of Microsoft is pushing is Internet Security Framework (ISF) which revolves around security through digital certificates, either resident in software form on a user's personal computer (PC) or stored on a portable Smart Card device.

On Internet, the hope is to build micro payment systems for small dollar value transactions. Electronic money could be created in any denomination, even very tiny ones to pay for say, expedited delivery of an e-mail message, and spent at the click of a mouse button. Anyone with a computer and a telephone line can become a small business without the hassle and expense of being approved as a credit-card accepting merchant and without opening a real shop. Given that e-cash will probably depend for its value on convertibility into traditional money, will it not ultimately be the domain of bankers rather than computer scientists?

In these small purchase systems, the cash transactions are anonymous.

b. Intermediate VCMS

There are two subcategories, depending on where the majority of the data is stored.

1. Value is stored primarily on the card (but with central knowledge and control)

   A future trend in this category is how to conveniently access the central system and reload the card's value. The EMV-standard chip card can be reloadable at any EMV-compatible automated tell machine (ATM), at telephones, point-of-sale (POS) terminals, and personal computers (PCs) equipped with Smart Card readers.

   The central question for e-cash designers is how to prevent digital cash and valuable information from being used over and over again. The simplest approach is to employ a central clearing mechanism that monitors every payment, preventing the same string of digits from being spent twice. The centralized model allows every payment to be monitored.

   In the case of CyberCoin , it is designed to tie into a consumer's checking account within a bank, so that after a consumer purchases an item the money moves from the consumer's bank

to the merchant's bank. In order to use CyberCoin, Web surfers first register with one of the participating banks, then download the bank-branded Wallet software and choose a password. The currency always resides at the bank instead of on the user's PC, then consumers can open a CyberCoin account by debiting their credit cards or turning the CyberCoin technology into their own checking accounts. CyberCoin is FDIC-insured. CyberCash is hoping to attracted the larger financial institutions to spread its Wallet Software where e-cash has stumbled

More ambitions efforts use a decentralized model where the valued information moves anonymously from card to card, just as coins and bills do today. In this decentralized model it is impossible to trace payments; this protects the privacy of the individual, but is a strong negative for law enforcement personnel. Less obviously, untraceable spending is also a negative for database-driven marketing, which is very important in the U.S.

2. Value is stored primarily in the computer system.

A key issue in this category is the need for, and development of digital cash payments. For example, Internet commerce must support spending cash such as digital cash (either separately or linked to credit cards or bank accounts).

The adoption of standards is also important to the future, wide spread use of any system. Standards are also important. EMV (Europay, MasterCard, Visa) is rapidly emerging as a standard for cards with a secure architecture in the chip that is upgradable so the company can adapt to new found weaknesses. To prevent multiple cards from being issued to single claimants, fingerprints are now being used for identification.

c. Complex VCMS

Complex VCMS have multiple interactions between VCMS managers and a customer. Here also there are two subsets depending on where a majority of the data is stored.

1. Value is stored primarily on the card (but with central knowledge and control)

These systems also require standards. The Secure Electronic Transactions (SET) protocol has been developed for online payments for merchants and consumers. Developed by both Visa and MasterCard, it is the underlying security framework behind emerging payment systems. It is rapidly emerging as an industry standard for ensuring the safe transmission of credit card numbers over the Internet.

Consumers fear too much information becomes available. Some development, such as First Virtual Holdings trade certifiable user identifiers rather than the user's credit number. In other systems, each transaction has a unique number that is logged. The specific steps of a First Virtual transaction are as follows:

- The buyer and seller both have accounts at the bank. The buyer gives the authority to First Virtual to make charges against his credit card.

- The buyer makes a purchase over the Internet by giving his account number to the seller, who ships the product.
- The merchant sends a list of who brought what to First Virtual.
- First Virtual e-mails messages to buyers to confirm the purchase.
- Once the buyer confirms, his/her credit card is charged and the money is transferred to the seller's account.

2. Value is stored primarily in the computer system, but subsets are stored on cards.

As mentioned above, a critical issue is how and where to reload the card.

VeriFone Inc. is designing a Smart Card application of a low-cost, portable automated teller machine (ATM), called the Personal ATM, designed for the home.

Over eight other companies, one of which is VeriSmart System, are developing devices such as the Personal ATM (P-ATM) as well as smart phones, personal computers (PC) and television set-top boxes to be used as front-ends for consumer Smart Card applications.

A new system for (almost) anonymity has emerged. E-cash blinding, used in the Conditional Access Program for Europe (CAFE) Project, a bank assigns a number that acts as an authentic unit of currency. That number is subsequently recalculated by the customer in such a way that the unique number remains valid, but the bank cannot know who has used the money. The only exception is that the user's identity can be disclosed if they spend a unit that has already been spent somewhere else.

3. *Classification of VCMS Applications*

Exhibit 5

VCMS APPLICATIONS BY VCMS CLASSIFICATIONS

Category	Comments	Simple VCMS	Value Primarily on Card	Value Primarily In Computer	COMPLEX VCMS
Electronic Purse (Mondex, Proton)	Anonymous Transactions	X			
Electronic Purse	With an audit trail for security		X		
"Campus" Card	Examples: University, Office, Library	X			
Reserved Travel	Current generation of "enhanced credit cards"			X	
Reserved Travel	Next-Generation Travel Smart Card				X
Unreserved Passenger Travel		X			
Vehicles-Tolls				X	
Vehicles-Congestion Control				X	
Vehicles-ID/Economically-oriented					X
Health-ID				X	
Social Services/Other Government					X
Telephone Cards-Next Generation		X			
Telephone-Cards Next Generation			X		
Electronic Couponing		X			
Loyalty Cards				X	
Vending Cards		X			
Gaming Cards				X	
Product Warranty					X

C. Forecast of Developments in VCMS

1. Trends in Use

This section describes emerging uses that will impact the overall smart card forecast should they develop rapidly. In part, greater usage depends on the application of Smart Cards (or the "virtual" equivalent, smart tokens) to activities users find useful. Examples of these likely uses includes:

a. Point-of-Sale Purchases

In place of a normal VISA card, a user has a Smart Card with a small embedded processor. When she wants to buy something, she hands over her card, and is asked to enter a PIN. After she does so, her card is handed back, and she's given a receipt. It should be impossible for anyone to capture enough information from the transaction to perform more transactions, and it should not be possible to get the smartcard to perform more than one transaction, either. (Perhaps the card takes 2-3 minutes to reset.) It's even possible for the smartcard to keep a log of this month's charges, and for the user to link it to a bigger machine at home to keep track of her bills. (This kind of close tracking by computer will catch many kinds of subtle fraud, where a criminal is stealing a few pennies per month from a lot of different accounts.)

b. Pay TV Access

Suppose each user in a cable or satellite TV network is equipped with a set-top box which does fast data decryption of the digitized TV signal. The box can contain a slot for a Smart Card, which allows access to certain premium channels. If each channel sends a new encrypted key (encrypted under that channel's master access key) every 10 seconds, the token can be very slow, and still keep the channel decrypted smoothly. Users can be given a new key once per month, or can have their key "recharged" in some way even more frequently. Some advantages to this scheme over current schemes are that a user can take his access with him, and that controlling access (for example, not letting his children watch R-rated movies) is as simple as locking the token up somewhere. In a world of 1,000 channels available everywhere, this kind of system allows convenience, and also enough security for the providers of the different channels. Similar schemes also make sense for audio-only or pure binary data channels.

c. Metering access to software

Another nice application for smart tokens is in application software metering. Ideally, a user would be able to load up a single token (perhaps a PCMCIA card) with the licensing information

for all her software. Each time she or one of her employees opened an application, that application's meter would be incremented by one. The metering might measure hours or minutes of application time used, maximum number of users, or might even bill specific functions of some applications more heavily than others. This kind of token mimics the little meters that are used in some printing/copying shops, where a user is given a meter, which is required to run the copying machines, and which counts the copies used. When the meter is returned, the user is charged for her copies. Similar metering schemes can be used for the pay-TV access (metering seconds or hours of viewing time, to be charged on the next bill), or for specific services like train or bus rides, where the token may be pre-loaded with a certain number of rides, and its counter is decremented each time a ride is authorized. The physical security of the token is trusted to prevent the user from decrementing the counters.

d. A physical "key" for digital signatures

Suppose a user has a specific secret key that she authorizes for use on contracts of up to $10 million. She may not feel comfortable trusting this key to her PC, since even if it's protected with a password, a really capable attacker might install some software to capture her password, and later, her key. There are digital signature schemes that require the cooperation of two parties. In this case, one of these can be a smart token, which has a small keypad for entering a PIN into the card. A million-dollar contract can't be signed without both smart token and PC being involved. The smart token can be kept physically locked up, and will be protected by a PIN in any event. Similarly, there are threshold signature schemes, which can be used to require the agreement of (say) three of five high-level executives in order to sign a major contract. Each of these executives can be given a smart token, and can be required to enter a PIN to allow the contract to be signed.

e. A toll-road pass

A Smart Card inside the user's car can allow immediate access to toll roads without stopping. As the user drives along the toll road, his token interacts with mileage stations every few miles, identifying him and incrementing his bill for the month. At the end of the month, he gets the bill. This can make driving on toll roads much faster, since there's no need to wait in line to pay a toll. This also allows variable tolls to be charged, so that driving in rush hour traffic can be discouraged.

f. Physical access control

A single Smart Card could be used for all the locks a user is supposed to be able to open--allowing quick access wherever he needs to be, including the office, his car, and his house. This kind of smart token should probably have a keypad, and require PIN numbers to operate. It should also require 15-30 seconds to reset after each attempt, so that it's impractical for a would-be burglar to sit outside the user's office and try 9,999 PINs.

g. Restricting access to remote computer systems

A physical Smart Card can be used to restrict access to a computer system accessible via Internet or modem. The computer system and the smart token can work through an interactive protocol that verifies both identities to one another, and can even agree on a session encryption key. This kind of system allows a user to log-in through an untrustworthy terminal, without leaving access to his remote account with the terminal. There are very simple systems like this in existence now—they use a calculator-like device, and the computer sends them a challenge-string of several digits, which they enter into their token. The token displays a response-string of several digits, which the user must type back at the computer. There are also one-time password systems in existence—in these, a new, apparently random password is used each time a user decides to log-in. The list of one-time passwords is supplied by a smart token, which either stores one-time passwords generated earlier, or else generates the next one-time password using some cryptographic algorithm. Note that all of these applications are useful because the Internet and public phone lines are not, in general, secure. An eavesdropper can easily listen in on a line, and capture a user's password. Challenge-response protocols and one-time passwords work as a 'pretty good' solution to this kind of problem.

h. Single-copy documents

If there is some document that needs to be readable, but not copyable, a smart token can act as that document. When someone reads the smart token, they first verify its identity, then read the contents of the token's document. This document may also be digitally signed by some kind of notary. So long as it's not possible for an attacker to recover the token's secret information, which it uses to identify itself, the token can't be copied. A single token can conceivably carry many such documents. Variations on this allow the token to "spend" the documents (perhaps they're rail or bus passes), deleting the special identifying information from each document as it is spent. Note that this doesn't prevent anyone from copying the document from the token—instead, it simply keeps them from claiming that their copy is the original.

i. Electronic Newspaper Subscriptions

If a user wishes to purchase a 6-month subscription to an electronic newspaper or news service, he buys a newspaper token (which may be a physical Smart Card). When he gets to a terminal (maybe in a hotel room), his token can authorize him to access the latest news from this newspaper. Probably, additional services will be made available for extra charges, such as more extensive photo coverage, or expanded coverage of specific areas of the news—these can also be known and authorized by the smart token.

j. Secure storage devices

Some Smart Cards hold significant amounts of flash-RAM, which can be used to hold secret user data. The token also holds some physically secure memory, which holds an encryption/decryption key. The user must enter the right PIN to gain access to the data. (Often, the PIN and the internally-stored data must both be used to determine the encryption/decryption key.) It is

possible to split the flash-RAM into many partitions, and encrypt each with different PINs and keys.

2. General Drivers in VCMS Use

Value circulation management systems have evolved on the technological front faster than users are willing or able to adopt the changes that are possible. These drivers--both positive and negative--impacting change are discussed below.

There are three main factors affecting future VCMS use

- Economic benefits and limitations
- User needs and requirements
- Public policy and government interaction

a. Economic Benefits and Limitations

Merchants are caught between the attractiveness of VCMS systems (e.g., money is transferred immediately from buyer to seller), the need to remain competitive with newer value systems, and the very high costs, both tangible and intangible, of changing from current practices. Benefits and costs have been addressed elsewhere, but the competitive driver has not.

The dilemma facing banks is that the introduction of electronic cash will not cut the cost of handling cash significantly unless consumers adopt new technology on a large scale. But, banks can't wait for widespread adoption for fear that non-bank competitors may launch electronic programs. Banks are now competing with nonbanks in cyberspace in multiple ways including the branded, multifunction Smart Card. One of the most feared competitors is Microsoft Corp. which is actively pursuing Smart Cards to enhance the value of its software on the Internet, including providing secure movement of electronic money, which may or may not include banks.

There is also resistance because of the need to protect the current market (e.g., credit cards, banks, retailers, businesses). Mondex, for example, can be a substitute for ATM. Visa and MasterCard want to develop an interest in pre-paid debit cards to get revenue from on-line authorizations and audit trails. Smart Cards could eliminate this revenue stream.

For consumers, the greatest obstacle facing electronic value lies with consumer attitudes--fear. Consumers seem to value some aspects of VCMS, notably the convenience in not requiring coins for vending, mass transit, and telephones. However, most or all of these benefits can be obtained with a non-VCMS value card. The bigger payoffs are clearly with issuers and acceptors who stand to benefit more from the relative cost savings than consumers.

- Discounts used to attract early adopters will certainly disappear as usage grows and some systems completely expose the consumer to loss if the value--stored only on the token without record elsewhere--is rendered unreadable or even stolen.

- In general, costs are higher--$1.00 to $8.00 per card. Merchants will want to recover these costs, the costs of conversion from current methods, and any costs associated with developing retail outlets where people buy cards. Most likely, customer will have to pay a monthly fee and retailers will pay either a monthly or annual fee.

VCMS operators (e.g., more complex systems where a third-party is involved) face dilemmas similar to merchants: the benefits of the new technology--especially the more extensive control over transactions it affords--and the cost of gaining this control. In some situations such as vehicular toll facilities, the financial benefits far outweigh the cost of the VCMS. In many other situations such as replacement for conventional credit cards, the costs may never be recovered.

b. User Needs and Requirements

Nomadic computing clearly characterizes the largest issues of the most likely users. These users and/or their valued information are moving and VCMSs seek to provide ease-of-use, convenience, and security in a consistent manner throughout this dynamic interplay of users--wherever they are--and information--wherever it is. Were either the user or the items of value to be stationary, there would not be the demand for this type of management and control.

Nomadic computing, where individuals or companies can easily access services, other people, and content while on the move, has several conditions that must be met for nomadic computing to be successful:

- Productivity must increase, allowing the right person to do the right job at the right time
- The personal touch must remain a part of the computing act
- The individual's environments (work, play, family, school) must remain intact
- Interactivity among individuals must be a part of the communications process

These requirements dictate several requirements for VCMS:

- They must be location independent. That is, communication is ultimately between parties--where ever they are--and not between locations (e.g., their desks or telephone numbers) where they are supposed to be.
- Nomads must have device independence such that the same activities can be accomplished through any number of devices that are currently available to the user.
- There must be widespread access so that users can do what they want electronically from where ever they are.
- All transactions must be secure.

- The interfaces must be friendly and based on similar, known devices for individuals to accept it.

- Environments must be partitioned so that users continue to enjoy there several worlds. (One option might be to give users several different telephone numbers, one for each environment.)

Of these, only convenience is being addressed. That notion of convenience has generally focused on the multifunctionality of devices (e.g. smart telephone cards, electronic money, ticketless travel, electronic access, storage of security tokens, and medical records):

- Smart Cards have 20-200 times the information of credit cards

- The microprocessor on Smart Cards offers 80 times the storage capacity of magnetic stripe technology. Smart Cards offer more security and the availability to include insurance data, medical history, driver's license, and cash value capacity.

Convenience also means ready access. First Union surveyed its pilot participants and found that people tend to spend more money when using debit or preloaded cards than when using cash. They also found that consumers object to reloading cards at automated teller machines which reinforces home telephone-based, or cell telephone-based, reloading capabilities.

c. Public Policy and Government Intervention

It is unknown just how Smart Cards will be regulated in the U.S. The Federal Reserve Board has proposed to apply Regulation E rules for electronic funds transfer to stored-value cards with respect to handling balances and transaction data. They separate regulations into:

- Off-line accountability stored-value systems (like debit cards and traditional deposit accounts)

- Off-line unaccountability stored-value systems (small dollar amount, single use)

- Online stored-value systems (similar to traditional deposit accounts accessed by debit cards)

There is a concern as to whether privately insured cards and electronic money will reduce the control of the FDIC and other federal banking regulators. But without government backing, some consumers may not feel comfortable using the electronic banking tools.

The government has replaced its 'key escrow' plan with a 'key recovery' plan. It requires that entities that export strong encryption technologies to place a 'key' to its encryption code in the hands of a 'trusted third party'. The 'trusted third party' can be part of the exporting company. Exporting companies can now export 56-bit encryption technologies under a six-month licenses from the Commerce Department.

The Federal reserve is still in the process of deciding the regulatory issues involved. Generally speaking, it appears that if a bank transfers dollar value to a Smart Card, it is essentially the same as a deposit and covered by applicable regulations. "E-Cash" not created by banks may be unregulated if below $100; E-Cash above $100 is still be evaluated.

3. Specific VCMS Drivers

The VCMS market is in a very early state of development. There are now many applications in unreserved travel and vehicle tolls. However, development in other industry/application areas is in early stages: Concept, planning, implementation and pilot trials.

There are many variables that will influence the direction, speed and size of VCMS markets. INPUT's analysis suggests very strongly that VCMS will be driven be the needs of particular markets. Some of the drivers will be specific to an industry or application. In other cases, certain countries or geographic regions may be ahead or behind others in the same application area.

INPUT has identified 8 general drivers that extent into many VCMS application areas:

1. Reducing expenses
2. Increasing sales , income
3. Improving quality of current information
4. Collecting new, important information
5. Speeding up process and/or saving time
6. Ease of use
7. "Fun" or interesting to use
8. Readiness of VCMS technology for a particular application

Most decisions regarding VCMS will be made by businesses (including governments). However, a VCMS will have to be used by individual consumers or business employees. In some cases the acceptance or attractiveness of a VCMS by consumers or employees will be critical to the success of a VCMS. Technology is important, but usually less of a determining factor than the perceived utility or attractiveness of a VCMS application.

Because of the high level of variability, combined with a very small market size today, conventional forecasts would show extremely high growth rates, but in INPUT's opinion would not be useful for planning or understanding the market. INPUT is presenting its forecasts in terms of probabilities and ranges:

- Probabilities for growth in VCMS share of a particular application or market
- A descriptive range of the potential market size for 1996, 2001, and 2006

The remainder of this chapter is organized as follows:

- A description of INPUT's overall approach
- Analyses of individual opportunities
- A summary forecast

4. The Attractiveness and Likely Market Penetration of VCMS Application

INPUT has assessed the likely market developments for a series of applications. The applications are

- The purchase of goods and services (physical purchase from retail merchants)
- The purchase of goods and services (electronic purchase via networks)
- Reserved travel (business travelers)
- Unreserved travel and vehicle tolls
- Vehicles - economic
- Health care
- Government-supplied services
- Specialized, large-scale services (focusing on telephone calls and gaming)
- Economic Exchange
- Product warranties

Each application was "graded" using the grid shown in Exhibit 5, scoring the VCMS potential for each of the general drivers by business, employees and consumers. (In many cases a driver may not be applicable to employees or consumers.) A similar "grading" system had been used for a project involving the purchase of goods and services, travel and health care. This analysis was updated and expanded to the other application areas. (Vehicles - economic and economic exchange were excluded from this section of the analyses since these markets are extremely immature and do not appear to have a significant amount of opportunity in the next ten years.) Four senior INPUT staff members took part in this evaluation process.

In addition, specific factors that affected the opportunity within a particular application/industry were also identified. Factors that were seen to be critical were also identified.

The next step was to estimate the probability of ranges of market share for each of the periods involved. Exhibit 6 shows the matrix employed. The original estimates were made by an INPUT staff most knowledgeable in the area; these estimates were reviewed by other INPUT staff members expert in Electronic Commerce and, after discussion, modified as necessary. INPUT staff knowledge devoted to this activity represented the experience gained on over 50 pertinent projects in the last 18 months.

The following sections summarize the results of the analysis for each application/industry area.

Exhibit 5

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function?

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses			
2. Increasing sales , income			
3. Improving quality of current information			
4. Collecting new, important information			
5. Speeding up process/save time			
6. Ease of use			
7. Fun to use			
8. Readiness of VCMS technology for application			

SPECIFIC ISSUES FOR THIS OPPORTUNITY	

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

Exhibit 6

VCMS MARKET PENETRATION SCENARIO

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)			
Medium (10-30%)			
High (30-50%)			
Very High (Over 50%)			

a. Purchase of Goods and Services (Physical)

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR PURCHASE OF GOODS & SERVICES (PHYSICAL)

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application? Credit cards, cash

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	B: reduces handling of cash	n/a	D
2. Increasing sales , income	D: unlikely to create new business	n/a	D
3. Improving quality of current information	D	n/a	n/a
4. Collecting new, important information	D	n/a	n/a
5. Speeding up process/save time	C: About same as cash; faster than credit card	n/a	D
6. Ease of use	C	D	D
7. Fun to use	n/a	D	D
8. Readiness of VCMS technology for application	B (will improve to A)	n/a	B(will improve to A)

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
Attractive to small, tax-avoiding businesses? *	No
Smart Cards more acceptable to consumers than credit cards in U.S. for small purchases (over $5)? *	No
Likely in U.S. to reduce use of cash significantly enough to change business processes or consumer behavior?	No
Positive feedback from pilot tests (Swindon, Atlanta)?*	No

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical issue

VCMS MARKET PENETRATION SCENARIO:

PURCHASE OF GOODS & SERVICES (PHYSICAL)

ESTIMATED MARKET PENETRATION	1996	2001	2006
None		20%	30%
Low (Up to 10%) *	100%	75%	60%
Medium (10-30%)		5%	10%
High (30-50%)			
Very High (Over 50%)			

Note: There have been adjustments made to this table since the prior draft.

* - Currently, this is a "low" market because of the tests going on and planned. In the future, INPUT believes, there is an appreciable chance (20-30%) that this type of VCMS will, in fact, fail and not be used at all. It is more likely, that there will be some niche uses and/or use in limited geographies.

b. Purchase of Goods & Services (electronic)

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR PURCHASE OF GOODS & SERVICES (ELECTRONIC)

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Credit cards

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	D	n/a	D
2. Increasing sales , income	D	n/a	n/a
3. Improving quality of current information	D	n/a	n/a
4. Collecting new, important information	D	n/a	n/a
5. Speeding up process/save time	D	n/a	D
6. Ease of use	D	n/a	D
7. Fun to use		n/a	n/a
8. Readiness of VCMS technology for application	B or C: untested, security questions (will improve to A)	n/a	B or C (will improve to A)

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
Security advantage of Smart Cards over credit cards which use a "trusted third party"?*	No
Are there "killer" I-Net applications waiting for <$1 payment mechanism?*	No
Are uncreditworthy I-Net customers attractive?	No
Is there evidence that consumers will prefer to "recharge" a Smart Card or Debit Card on a home PC with a special appliance?*	No

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical issues, driven by the following

- Credit cards will offer at least as much security.
- The large scale, fractional-cent applications which are supposed to drive these kinds of VCMS are not in evidence.
- Rechargeable Smart Cards would appeal to those who cannot obtain a credit card; this is not an attractive population.
- There is no consumer research supporting home "recharging" of a Smart Card.

VCMS MARKET PENETRATION SCENARIO: PURCHASE OF GOODS & SERVICES (ELECTRONIC)

ESTIMATED MARKET PENETRATION	1996	2001	2006
None		20%	30%
Low (Up to 10%)	100%	70%	50%
Medium (10-30%)		10%	10%
High (30-50%)			10%
Very High (Over 50%)			

c. Reserved Travel/Business Travelers

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR RESERVED TRAVEL/BUSINESS TRAVELERS

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? A combination credit card/Smart Card is being compared to conventional credit cards, paper-based expense reimbursement systems and manual input PC-based expense reporting systems.

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A*	n/a	n/a
2. Increasing sales , income	n/a	n/a	n/a
3. Improving quality of current information	A	n/a	n/a
4. Collecting new, important information	A*	n/a	n/a
5. Speeding up process/save time	A	A*	n/a
6. Ease of use	B	C (1996), A (1998) **	n/a
7. Fun to use	n/a	C	n/a
8. Readiness of VCMS technology for application	D (1996), B (1998), A (1999)	D (1996), B (1998), A (1999)	n/a

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
Do one or more credit card companies need to take the initiative?	Yes
Is it likely that major airlines and hotel chains will participate?	Probably

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

** The "next-generation" Smart Card will let business travelers prepare expense reports easily. (See attached materials)

VCMS MARKET PENETRATION SCENARIO: RESERVED TRAVEL/BUSINESS TRAVELERS

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)	100%	25%	
Medium (10-30%)		50%	
High (30-50%)		25%	50%
Very High (Over 50%)			50%

Note: There have been adjustments made to this table since the prior draft.

d. Unreserved Travel And Vehicle Tolls

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR UNRESERVED TRAVEL AND VEHICLE TOLLS

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Cash, paper tickets, printed passes, metal tokens

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A*	D: reduce employment	A
2. Increasing sales , income	B: more flexible	D: reduce employment	n/a
3. Improving quality of current information	C: potential	n/a	n/a
4. Collecting new, important information	C: potential	n/a	n/a
5. Speeding up process/save time	A*	D: reduce employment	A
6. Ease of use	A	n/a	A*
7. Fun to use	n/a	D: reduce employment	C
8. Readiness of VCMS technology for application	A	D: reduce employment	A

SPECIFIC ISSUES FOR THIS OPPORTUNITY	

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

VCMS MARKET PENETRATION SCENARIO: UNRESERVED TRAVEL AND VEHICLE TOLLS

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)			
Medium (10-30%)	100%	20%	
High (30-50%)		80%	
Very High (Over 50%)			100%

e. Health Care

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR HEALTH CARE

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Conventional insurance/medical identification, hospital medical records (automated and unautomated), regional health record networks
- The U.S. and Europe are contrasted because of the different health care systems

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Business (Insurer, Health Provider)**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A* (US), B (Eur)	n/a	A (US), D (Eur)
2. Increasing sales , income	A* (US), C (Eur)	n/a	n/a
3. Improving quality of current information	A* (US), A* (Eur)	A (US, Eur)	A (US, Eur)
4. Collecting new, important information	A* (US), B (Eur)	A (US, Eur)	n/a
5. Speeding up process/save time	A* (US), A* (Eur)	A (US, Eur)	B (US, Eur)
6. Ease of use	B (US, Eur)	n/a	B (US, Eur)
7. Fun to use	C (US, Eur)	n/a	B (US, Eur)
8. Readiness of VCMS technology for application	C (1996), B (1999)	n/a	C (1996), B (1999)

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
How soon will there be common data content standards (mainly Europe)?	1999 **
In the U.S. will it be difficult to link Smart Cards to decentralized medical record systems (in order to always have current, correct medical information)?	Yes -- Will take 2-3 years for progress; initially limited to certain regions

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

** Several European countries (Germany, Spain, France) are working on health data standards. INPUT estimates that it will be two more years before there are some standards which address health records.

VCMS MARKET PENETRATION SCENARIO: HEALTH CARE

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)	100%	50%	20%
Medium (10-30%)		30%	30%
High (30-50%)		20%	40%
Very High (Over 50%)			10%

f. Vehicles -- Economic

VCMS MARKET PENETRATION SCENARIO

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)	100%	99%	95%
Medium (10-30%)		1%	5%
High (30-50%)			
Very High (Over 50%)			

g. Government-Supplied Services

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR GOVERNMENT-SUPPLIED SERVICES

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Manual systems and/or paper-based identification.
- Note: This analysis is limited to targeted services, such as social services and education. INPUT believes the political resistance and the technical difficulty of providing a comprehensive national identification and service will be too great for many implementations in the next ten years.

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Business (Government)**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A*	n/a	n/a
2. Increasing sales , income	n/a	n/a	n/a
3. Improving quality of current information	A	n/a	n/a
4. Collecting new, important information	A*	n/a	n/a
5. Speeding up process/save time	B	B	B
6. Ease of use	B	B	B
7. Fun to use	C	n/a	D (Many will like improved service; others will dislike intrusiveness)
8. Readiness of VCMS technology for application	B (1996), A (1998)	n/a	n/a

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
May some systems be too intrusive and delay acceptance?	Yes

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

VCMS MARKET PENETRATION SCENARIO: GOVERNMENT-SUPPLIED SERVICES

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)	100%	20%	
Medium (10-30%)		40%	20%
High (30-50%)		30%	60%
Very High (Over 50%)		10%	10%

h. Specialized Services

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR SPECIALIZED SERVICES

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Conventional credit cards, first generation stored-value cards, cash
- Note: This analysis focuses on telephone cards and gaming cards for simple games of chance(e.g., lotteries and slot machines)

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A*	n/a	C
2. Increasing sales , income	A*	n/a	n/a
3. Improving quality of current information	A	n/a	n/a
4. Collecting new, important information	A	n/a	n/a
5. Speeding up process/save time	B	n/a	C
6. Ease of use	A	C: Reduces cash handling	C
7. Fun to use	C	D: Increased control for gaming employees	C
8. Readiness of VCMS technology for application	C (1996), B (1998)	n/a	n/a

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
If VCMS (especially Smart Card component) can fully meet real and perceived security requirements will it replace much of cash/physical tokens now used in gaming?	Yes

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

VCMS MARKET PENETRATION SCENARIO: SPECIALIZED SERVICES

ESTIMATED MARKET PENETRATION	1996	2001	2006
None			
Low (Up to 10%)	100%	10%	5%
Medium (10-30%)		10%	5%
High (30-50%)		60%	10%
Very High (Over 50%)		20%	80%

i. Economic Exchange

VCMS MARKET PENETRATION SCENARIO:

ESTIMATED MARKET PENETRATION	1996	2001	2006
None	100%	50%	50%
Low (Up to 10%)		40%	20%
Medium (10-30%)		10%	20%
High (30-50%)			10%
Very High (Over 50%)			

j. Product Warranty

"GRADING" THE ATTRACTIVENESS OF VCMS APPLICATIONS FOR PRODUCT WARRANTY

(Grade is for 1996 - 2006, unless otherwise noted)

- What alternative is the VCMS being compared to for this application/function? Individual, isolated systems (usually a combination of automated and unautomated processes)

	ATTRACTIVENESS TO DIFFERENT CLASSES OF CUSTOMER		
VCMS POTENTIAL (General Issues)	**Businesses**	**Business Employees**	**Individuals as Consumers**
1. Reducing expenses	A*	n/a	n/a
2. Increasing sales , income	B (if developed by one company; see trade-off below)	n/a	n/a
3. Improving quality of current information	A*	n/a	A*
4. Collecting new, important information	A*	n/a	A*
5. Speeding up process/save time	A*	B	A*
6. Ease of use	B	B	n/a
7. Fun to use	C	C	n/a
8. Readiness of VCMS technology for application	D (1996), B? (1999)	n/a	n/a

SPECIFIC ISSUES FOR THIS OPPORTUNITY	
Need for common data standards?	Yes (difficult)
Need for integration along a supply chain (manufacturer, wholesaler, retailer, service companies)?	Yes
Can this business be developed by a single manufacturer?	Yes: Trade-off between marketing benefits for a single manufacturer and functional improvements if implemented jointly within an industry

A = Very attractive, significant advantages over alternatives
B = Attractive, some advantages over alternatives
C = Marginally attractive, few advantages over alternatives
D = Not attractive; no advantages over alternatives
n/a = not applicable (this group is not a factor for this application)

* Critical Issue

VCMS MARKET PENETRATION SCENARIO: PRODUCT WARRANTY

ESTIMATED MARKET PENETRATION	1996	2001	2006
None	100%	10%	5%
Low (Up to 10%)		50%	40%
Medium (10-30%)		40%	40%
High (30-50%)			15%
Very High (Over 50%)			

5. Summary Forecast

To calculate forecasts for the VCMS market, INPUT first estimated the size of the potential VCMS market (Exhibit 7)

- The figures contain estimated VCMS vendor revenues for specialized hardware, software and services as well as estimates for general-purpose products and services with a high VCMS component.
- The actual figures may vary greatly from these because of changes in the market as well as the difficulty in apportioning general-purpose products and services between VCMS and non-VCMS activities. This apportionment will become increasingly difficult in applications and industries where VCMS becomes and important factor.

INPUT then applied the high and low penetration rates from the preceding section.

- Zero or very low values at the bottom of the range represent the probability that there may be no market or that there will be pilot operations only.
- The larger amounts represents higher probabilities and/or a very large underlying market for the services the VCMS may supplement or replace.

Exhibit 7

POTENTIAL WORLDWIDE VCMS MARKET SIZE ($ BILLION)

VCMS Application/Industry	1996	2001	2006
Purchase of goods and services (physical)	10	40	60
Purchase of goods and services (electronic)	1	20	30
Reserved travel (business travelers)	0.5	3	10
Unreserved travel and vehicle tolls	3	5	10
Vehicles - economic	0.2	0.2	5
Health care	1	3	5
Government-supplied services	2	5	15
Specialized services	2	10	15
Economic Exchange	0.1	3	5
Product Warranties	0	10	30

Source: INPUT Estimates

Even with the large amount of variation in the dollar ranges, INPUT believes that this information is very useful.

- It highlights the largest market opportunities
- It also shows the high level of variability -- and risk -- associated with different markets.

INPUT recommends that these forecasts be reexamined, refines and updated every 6-12 months.

Exhibit 8

WORLDWIDE VCMS MARKET SIZE ($ BILLION)

VCMS Application/Industry	1996	2001	2006
Purchase of goods and services (physical)	<0.1	0-10.0	0-10.0
Purchase of goods and services (electronic)	<0.1	0-5.0	0-10.0
Reserved travel (business travelers)	<0.1	0.1-1.0	3.0-10.0
Unreserved travel and vehicle tolls	0.5-1.0	1.0-2.0	3.0-10.0
Vehicles - economic	<0.1	<0.1	0.1-1.0
Health care	0.1-0.2	0.5-1.0	1.0-3.0
Government-supplied services	0.1-0.2	0.5-5.0	1.0-10.0
Specialized services	0.1-0.2	3.0-10.0	5.0-10.0
Economic Exchange	0	0-0.5	0.1-0.5
Product Warranties	0	0-5.0	0-10.0

Note: There have been adjustments made to this table since the prior draft.

As stated earlier, the VCMS market is in a very early state of development and there are many, many variables that will influence the direction, speed and size of VCMS markets. INPUT's analysis suggests very strongly that VCMS will be driven be the needs of particular markets. Some of the drivers will be specific to an industry or application. In other cases, certain countries or geographic regions may be ahead or behind others in the same application area.

Because of the high level of variability, combined with a very small market size today, conventional forecasts would show extremely high growth rates, but in INPUT's opinion would not be useful for planning or understanding the market. INPUT is presenting its forecasts in terms of probabilities and ranges.

Exhibit 9 below presents INPUT's dollar forecasts for the worldwide VCMS market.

- The figures contain estimated VCMS vendor revenues for specialized hardware, software and services as well as estimates for general-purpose products and services with a high VCMS component.

- The actual figures may vary greatly from these because of changes in the market as well as the difficulty in apportioning general-purpose products and services between VCMS and non-VCMS activities. This apportionment will become increasingly difficult in applications and industries where VCMS becomes an important factor.

- Zero or very low values at the bottom of the range represent the probability that there may be no market or that there will be pilot operations only.

- The larger amounts represent higher probabilities and/or a very large underlying market for the services the VCMS may supplement or replace.

Even with the large amount of variation in the dollar ranges, INPUT believes that this information is very useful:

- It highlights the largest market opportunities.
- It also shows the high level of variability -- and risk -- associated with different markets.

INPUT recommends that these forecasts be reexamined, refined and updated every 6-12 months.

Exhibit 9

WORLDWIDE VCMS MARKET SIZE ($ BILLIONS)

VCMS APPLICATION/INDUSTRY	1996	2001	2006
Purchase of goods and services (physical)	<0.1	0-10.0	0-10.0
Purchase of goods and services (electronic)	<0.1	0 - 5.0	0-10.0
Reserved travel (business travelers)	<0.1	0.1-1.0	3.0-10.0
Unreserved travel and vehicle tolls	0.5-1.0	1.0-2.0	3.0-10.0
Vehicles - economic	<0.1	<0.1	0.1-1.0
Health care	0.1-0.2	0.5-1.0	1.0-3.0
Government-supplied services	0.1-0.2	0.5-5.0	1.0-10.0
Specialized services	0.1-0.2	3.0-10.0	5.0-10.0
Economic Exchange	0	0 - 0.5	0.1-0.5
Product warranties	0	0-5.0	0-10.0

Note: There have been adjustments made to this table since the prior draft.

D. Summary and Conclusions

In order for VCMS to succeed, they must

- Add value
- Be perceived to add value
- Reach critical mass quickly

"Adding value" takes the form of providing value that cannot easily be obtained elsewhere. For example, VCMS for purchases of physical products may add value in some circumstances and not in others:

- In the U.S. credit cards are
- Already held by over 100 million people
- Widely accepted
- Accepted for very small transactions(e.g., under $2)
- Consequently, a cash replacement VCMS has little to offer.
- Credit cards have lower penetration in Europe and are generally not accepted for small purchases. However, credit cards are being strongly pushed in Europe; this argues that a cash replacement VCMS may have a limited window of opportunity.
- In Asian countries, on the other hand, credit cards are less widely used and cash is still very important for everyday transactions. In this environment, a cash replacement VCMS may be a very valid long term proposition.

The Mondex and other "cash replacement" tests have shown that a very high penetration of both merchants and consumers is necessary for success; in addition, consumers have to change their habits.

An example of the difficulty in changing habits is the Smart Card use on New York City subways and buses: In spite of many attractive features, use has been much lower than expected. New York City Transit will "solve" this problem by refusing to accept metal tokens by the end of 1997.

In INPUT's opinion, this type of mandating will be the key to success for many VCMS. That is, where the VCMS operates in a closed environment, the VCMS manager(s) can require that Smart Cards be used. Monopoly operators of unreserved transportation are adopting VCMS as a way of controlling their costs, and in some cases, offering advantages to their customers.

The Travel Smart Card is an example of where a small number of vendors and corporations can agree on a new type of transaction mechanism.

- Government benefits, and gaming are other examples of a single VCMS manager being able to mandate the use of a VCMS.

In these examples, using the VCMS will be, at the least acceptable to consumers as a change in the method of payment.

Novel VCMS applications, such as economic exchange and product warranties, will require cooperation from many equal system users to construct new systems. Consequently, progress will be much slower in these areas.